SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

NEW SERIES. VOLUME XVII.

JANUARY-JUNE, 1903.

NEW YORK
THE MACMILLAN COMPANY
1903

THE NEW ERA PRINTING COMPANY,
41 North Queen Street,
Lancaster, Pa.

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N. S. VOL. XVII.—JANUARY TO JUNE, 1903.

The Names of Contributors are Printed in Small Capitals.

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FRIDAY, JANUARY 2, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*THE SCIENCE OF ASTRONOMY.**

I TAKE for the subject of my address the science of astronomy, and propose to give a brief historical sketch of it, to consider its future development, and to speak of the influence of the sciences on civilization.

The science of astronomy is so closely connected with the affairs of life, and is brought into use so continuously and in such a systematic manner, that most people never think of the long labor that has been necessary to bring this science to its present condition. In the early times it was useful to the legislator and the priest, for keeping records, the times of public ceremonies and of religious festivals. It slowly grew into the form of a science, and became able to make predictions with some certainty. This was many centuries ago. Hipparchus, who lived 150 B.C., knew the periods of the six ancient planets with considerable accuracy. His periods are:

	Period.	$\frac{\text{Error} \times 100}{\text{Period}}$.
Mercury	$87^d.9698$	$+ 0^d.0007$
Venus	224.7028	+ 0.0009
Earth	365.2599	+ 0.0010
Mars	686.9785	— 0.0002
Jupiter	4332.3192	— 0.0061
Saturn	10758.3222	— 0.0083

* Address of the President of the American Association for the Advancement of Science, Washington meeting, December 29, 1902.

These results indicate that more than two thousand years ago there existed recorded observations of astronomy. Hipparchus appears to have been one of those clear-headed men who deduce results from observations with good judgment. There was a time when those ancient Greek astronomers had conceived the heliocentric motions of the planets, but this true theory was set aside by the ingenious Ptolemy, who assumed the earth as the center of motion, and explained the apparent motions of the planets by epicycles so well that his theory became the one adopted in the schools of Europe during fourteen centuries. The Ptolemaic theory flattered the egotism of men by making the earth the center of motion, and it corresponded well with old legends and myths, so that it became inwoven with the literature, art and religion of those times. Dante's construction of Hell, Purgatory and Paradise is derived from the Ptolemaic theory of the universe. His ponderous arrangement of ten divisions of Paradise, with ten Purgatories and ten Hells, is said by some critics to furnish convenient places for Dante to put away his friends and his enemies, but it is all derived from the prevailing astronomy. Similar notions will be found in Milton, but modified by the ideas of Copernicus, which Milton had learned in Italy. The Copernican theory won its way slowly, but surely, because it is the system of nature, and all discoveries in theory and practical astronomy helped to show its truth. Kepler's discoveries in astronomy, Galileo's discovery of the laws of motion and Newton's discovery of the law of gravitation, put the Copernican theory on a solid foundation. Yet it was many years before the new theories were fully accepted. Dr. Johnson thought persecution a good thing, since it weeds out false men and false theories. The Copernican and Newtonian theories have stood the test of observation and criticism, and they now form the adopted system of astronomy.

The laws of motion, together with the law of gravitation, enable the astronomer to form the equations of motion for the bodies of our solar system; it remains to solve these equations, to correct the orbits, and to form tables of the Sun, Moon and the planets. This work was begun more than a century ago, and it has been repeated for the principal planets several times, so that now we have good tables of these bodies. In the case of the principal planets the labor of determining their orbits was facilitated by the approximate orbits handed down to us by the ancient astronomers; and also by the peculiar conditions of these orbits. For the most part the orbits are nearly circular; the planets move nearly in the same plane, and their motions are in the same direction. These are the conditions Laplace used as the foundation of the nebular hypothesis. With approximate values of the periods and motions, and under the other favoring conditions, it was not difficult to form tables of the planets. However the general problem of determining an orbit from three observations, which furnish the necessary and sufficient data, was not solved until about a century ago. The orbits of comets were first calculated with some precision. Attention was called to these bodies by their threatening aspects, and by the terror they inspired among people. It was therefore a happy duty of the astronomers to show that the comets also move in orbits around the Sun, and are subject to the same laws as the planets. This work was easier because the comets move nearly in parabolas, which are the simplest of the conic sections. Still the general problem of finding the six ele-

ments of an orbit from the six data given by three observations remained to be solved. The solution was given by Gauss a century ago in a very elegant manner. His book is a model, and one of the best ever written on theoretical astronomy. No better experience can be had for a student than to come in contact with such a book and with such an author. The solution of Laplace for the orbit of a comet is general, but demands more labor of computing than the method of Olbers, as arranged by Gauss. It is said by some writers that the method of Laplace is to be preferred because more than three observations can be used. In fact this is necessary in order to get good values of the derivatives of the longitudes and latitudes with respect to the time, but it leads to long and rather uncertain computations. Moreover it employs more data than are necessary, and thus is a departure from the mathematical theory of the problem. This method is ingenious, and by means of the derivatives it gives an interesting rule for judging of the distance of a comet from the earth by the curvature of its apparent path, but a trial shows that the method of Olbers is much shorter. Good preliminary orbits can now be computed for comets and planets without much labor. This, however, is only a beginning of the work of determining their actual motions. The planets act on each other and on the comets, and it is necessary to compute the result of these forces. Here again the conditions of our solar system furnish peculiar advantages. The great mass of the sun exerts such a superior force that the attractions of the planets are relatively small, so that the first orbits, computed by neglecting this interaction, are nearly correct. But the interactions of planets become important with the lapse of time, and the labor of computing these perturbations is very great. This work has been done repeatedly, and we now have good numerical values of the theories of the principal planets, from which tables can be made. Practically, therefore, this question appears to be well toward a final solution. But the whole story has not been told.

The planets, on account of their relative distances being great and because their figures are nearly spherical, can be considered as material particles and then the equations of motion are readily formed. In the case of n material particles acting on each other by the Newtonian law, and free from external action, we shall have $3n$ differential equations of motion, and $6n$ integrations are necessary for the complete solution. Of these only ten can be made, so that in the case of only three bodies there remain eight integrations that cannot be found. The early investigators soon obtained this result, and it is clearly stated by Lagrange and Laplace. The astronomer, therefore, is forced to have recourse to approximate methods. He begins with the problem of two bodies, the sun and a planet, and neglects the actions of the other planets. In this problem of two bodies the motions take place in a plane, and the integrations can all be made. Two constants are needed to fix the position of the plane of motion, and the four other constants pertaining to the equations in this plane are easily found. This solution is the starting point for finding the orbits of all the planets and comets. The mass of the sun is so overpowering that the solution of the problem of two bodies gives a good idea of the real orbits. Then the theory of the variation of the elements is introduced, an idea completely worked out into a practical form by Lagrange. The elements of the orbits are supposed to be continually changed by the attractions of

the other planets. By means of this theory, and the mathematical machinery given by Lagrange, which can be applied to a great variety of questions, the observations of the planets can be satisfied over long intervals of time. When this theory of the motions was carried out a century ago it appeared that the great problem of planetary motion was near a complete solution. But this solution depends on the use of series, which undergo integrations that may introduce small divisors. An examination of these series by Hansen, Poincaré and others indicates that some of them are not convergent. Hence the conclusions formerly drawn about the stability of our solar system are not trustworthy, and must be held in abeyance. But looking at the construction of our system, and considering the manner in which it was probably evolved, it appears to be stable. However the mathematical proof is wanting. In finding the general integrals of the motions of n bodies, the assumption that the bodies are particles gets rid of the motions of rotation. These motions are peculiar to each body, and are left for special consideration. In the case of the earth this motion is very important, since the reckoning of time, one of our fundamental conceptions, depends on this motion. Among the ten general integrals that can be found six belong to the progressive motion of the system of bodies. They show that the center of gravity of the system moves in a right line, and with uniform velocity. Accurate observations of the stars now extend over a century and a half, and we are beginning to see this result by the motion of our sun through space. So far the motion appears to be rectilinear and uniform, or the action of the stars is without influence. This is a matter that will be developed in the future. Three of the other general integrals belong to the theory of areas, and Laplace has drawn from them his theory of the invariable plane of the system. The remaining integral gives the equation of living force. The question of relative motion remains, and is the problem of theoretical astronomy. This has given rise to many beautiful mathematical investigations, and developments into series. But the modern researches have shown that we are not sure of our theoretical results obtained in this way, and we are thrown back on empirical methods. Perhaps the theories may be improved. It is to be hoped that the treatment of the differential equations may be made more general and complete. Efforts have been made in this direction by Newcomb and others, and especially by Gyldèn, but so far without much practical result.

The problem of three bodies was encountered by the mathematicians who followed Newton, and many efforts were made to solve it. These efforts continue, although the complete investigations of Lagrange appear to put the matter at rest. The only solutions found are of very special character. Laplace used one of these solutions to ridicule the doctrine of final causes. It was the custom to teach that the moon was made to give us light at night. Laplace showed by one of the special solutions that the actual conditions might be improved, and that we might have a full moon all the time. But his argument failed, since such a system is unstable and cannot exist in nature. But some of the efforts to obtain partial solutions have been more fruitful, and G. W. Hill has obtained elegant and useful results. These methods depend on assumed conditions that do not exist in nature, but are approximately true. The problem of two bodies is a case of this kind, and the

partial solutions may illustrate, but will not overcome, the fundamental difficulty.

The arrangement of our solar system is such that the distances of the planets from one another are very great with respect to their dimensions, and this facilitates very much the determination of their motions. Should two bodies approach very near each other the disturbing force might become great, even in the case of small masses. In the case of comets this condition happens in nature, and the comet may become a satellite of a planet, and the sun a disturbing body. In this way it is probable that comets and meteoric streams have been introduced into our solar system. We have here an interesting set of problems. This question is sometimes treated as one of statics, but since the bodies are in motion it belongs to dynamics. Further study may throw light on some relations between the asteroids and the periodical comets.

The great question of astronomy is the complete and rigorous test of the Newtonian law of gravitation. This law has represented observations so well during a century and a half that it is a general belief that the law will prove true for all time, and that it will be found to govern the motions of the stars as well as those of our solar system. The proof is cumulative and strong for this generality. It will be a wonderful result if this law is found rigorously true for all time and throughout the universe. Time is sure to bring severe tests to all theories. We know that the law of gravitation is modified in the motions of the matter that forms the tails of comets. There is an anomaly in the theory of Mercury which the law does not explain, and the motion of our moon is not yet represented by theory. The lunar theory is very complicated and difficult, but it does not seem probable that the defect in Hansen's theory will be found by recomputing the periodical coefficients, that have been already computed by many mathematicians and astronomers, and with good agreement by Hansen and Delaunay, by very different methods. Hansen was a computer of great skill, but he may have forced an agreement with observations, from 1750 to 1850, by using a coefficient of long period with an erroneous value. No doubt the error of this theory will be discovered. Back of all theories, however, remains the difficulty of solving the equations of motion so that the result can be applied with certainty over long periods of time. Until this is done we shall not be able to subject our law to a crucial test.

The constants that enter the theories of the planets and moon must be found from observations. In order to compare observations made at distant epochs, the motions of the planes of reference must be known with accuracy, and also the motion of our solar system in space. As the stars are our points of reference their positions and their proper motions must be studied with great care. This department of astronomy was brought to a high degree of order by the genius of Bessel, whose work forms an epoch in modern astronomy. The recent progress made in determining the positions of the stars in all parts of the heavens will be a great help to the investigations of the future. We must have observatories where accurate and continuous observations are made. Our country is well situated to supplement the work of Europe, and we hope it will never fail to add its contribution to the annals of astronomy. American astronomers should keep pace in the improvements for increasing the ease and accuracy of making observations. The spectroscope has given a new element in the motions of the stars, not to speak of the interesting physical re-

sults obtained by its use. Photography will give great aid in determining the relative positions of the stars and in forming maps of the heavens. All new methods, however, will need examination and criticism, since they bring new sources of error. Fifty years ago it was thought the chronograph would increase very much the accuracy of right ascensions. It has not done this directly to any great extent, but it has increased the ease and rapidity of observing. We must remember that astronomical results finally depend on meridian observations, and that it is the duty of astronomers to make these continuous from generation to generation. In this way we shall gain the powerful influence of time to help control and solve our problems. There is one point where a reform may be needed from the dead weight of the large and expanding volumes sent forth by observatories and scientific institutions. The desire for publication is great, but the results should be well discussed and arranged, so that the printing may be shortened. Otherwise our publications may become burdensome, and when they are piled up in libraries some future Caliph Omar may be tempted to burn them. Even mathematics appears to labor under a similar oppression, and much of its printed matter may be destined to moulder to useless dust.

In the not distant future stellar astronomy will become a great and interesting field of research. The data for the motions of the stars are becoming better known, but these motions are slow, and the astronomer of to-day looks with envy on the astronomer of a thousand years hence, when time will have developed these motions. Much may be done by the steady and careful work of observation and discussion, and the accumulation of accurate data. Here each one of us can add his mite. But the great steps of progress in science have come from the efforts of individuals. Schools and universities help forward knowledge by giving to many students opportunities to learn the present conditions, and from them some genius like Lagrange or Gauss may come forth to solve hard questions, and to break the paths for future progress. This is about all the schools can do. We need a body of men who can give their lives to quiet and continuous study. When the young Laplace was helped to a position where he could devote his life to research D'Alembert did more for the progress of astronomy than all the universities of Europe.

One needs only to glance at history to see how useful astronomy has been in the life of the world. It has wonderfully enlarged the universe, and widened the views of men. It shows how law and order pervade the world in which we live; and by the knowledge it has disseminated and by its predictions it has banished many superstitions and fears. The sciences will continue to grow; and they will exert the same influence. The erroneous and dogmatic assertions of men will be pushed aside. In our new country the energies of the people are devoted chiefly to commercial and political ends, but wealth is accumulating, leisure and opportunity will come, and we may look forward to a great development of scientific activity. We must be patient. Men do not change much from generation to generation. Nations that have spent centuries in robbery and pillage retain their dispositions and make it necessary for other nations to stand armed. No one knows when a specious plea for extending the area of civilization may be put forth, or when some fanatic may see the hand of God beckoning him to seize a country. The progress of science and invention will

render it more difficult for such people to execute their designs. A century hence it may be impossible for brutal power, however rich and great, to destroy a resolute people. It is in this direction that we may look for international harmony and peace, simply because science will make war too dangerous and too costly.

The influence of the sciences in bringing men of different nationalities into harmony is great. This is done largely by the common languages that are formed in each science. In mathematics the language is so well formed and generally adopted that mathematicians all over the world have no trouble in understanding one another. It may be difficult to read Russian, but every one can read the formulas of Tchebitchef and Lobaschewsky. In astronomy the common language is nearly as well established, so that there is little difficulty in understanding the astronomy of different nations. A similar process is going on in chemistry, botany and in the other sciences. When men are striving for the discovery of truth in its various manifestations, they learn that it is by correcting the mistakes of preceding investigators that progress is made, and they have charity for criticism. Hence persecution for difference of opinion becomes an absurdity. The labors of scientific men are forming a great body of doctrine that can be appealed to with confidence in all countries. Such labors bring people together, and tend to break down national barriers and restrictions. The scientific creed is constantly growing and expanding, and we have no fears, but rejoice at its growth. We need no consistory of bishops, nor synod of ministers, to tell us what to believe. Everything is open to investigation and criticism.

In our country we have one of the greatest theaters for national life that the world has ever seen. Stretching three thousand miles from ocean to ocean, and covering the rich valleys of the great rivers, we have a land of immense resources. Here is a vast field for scientific work of various kinds. No doubt the men of the future will be competent to solve the problems that will arise. Let us hope that our national character will be just and humane, and that we may depart from the old custom of robbing and devouring weak peoples. Any one who saw the confusion and waste in this city in 1862 might well have despaired of the Republic; and he who saw the armies of Grant and Sherman pass through the city in 1865 felt that he need fear no foreign foe: neither French emperor, nor English nobleman nor the sneers of Carlyle. To destroy a democracy by external force the blows must be quick and hard, because its power of recuperation is great. The danger will come from internal forces produced by false political and social theories, since we offer such a great field for the action of charlatans. Our schools and colleges send forth every year many educated people, and it is sometimes disheartening to see how little influence these people have in public life. Those who are trained in the humanities and churches ought to be humane in dealing with other people, ready to meet great emergencies and powerful to control bad tendencies in national affairs. But this is rarely the case. On the other hand the most unscrupulous apologists and persecutors have been educated men, and the heroes of humanity have come from the common people. This anomaly points to something wrong in the system of education, which should disappear. The increase and teaching of scientific ideas will be the best means of establishing simple and natural rules of life. Nature, and science her interpreter, teach us to be

honest and true, and they lead us to the Golden Rule. Asaph Hall.

POPULAR SCIENCE.*

Ladies and Gentlemen: Five years ago I prepared a sketch of an address which I expected to deliver as retiring president of the Iowa Academy of Science. I was not able to deliver the address, however, on account of enforced absence from the Des Moines meeting of the Academy at Christmas time, 1897. It was my intention in that address to speak in terms of commendation of some of the ideas advanced by Professor Woodrow Wilson in his then recent address given on the occasion of the Sesquicentennial celebration of Princeton University. Professor Wilson's recent promotion to the presidency of Princeton University has called his Sesquicentennial address again to our minds, and it seems to me that I may very properly say now what I had intended to say in 1897, especially inasmuch as no one, speaking for science, has expressed any degree of sympathy with President Wilson's point of view. I hope to make my meaning so clear and definite as to render it unnecessary for me to limit or qualify my general expression of sympathy with Professor Wilson; although the words he has used in his Sesquicentennial address are certainly open to an interpretation which no seriously minded man of science could possibly accept.

In order that we may enter upon this subject with some degree of mutual understanding, I think it is necessary to quote President Wilson at some length. He says, "I am much mistaken if the scientific spirit of the age is not doing us a great disservice, working in us a certain great degeneracy. Science has bred in us a spirit of experiment and a contempt for the past, * * *" yet "I have no indictment against what science has done: I have only a warning to utter against the atmosphere which has stolen from our laboratories into lecture rooms and into the general air of the world at large. * * *" Science "has driven mystery out of the universe; it has made malleable stuff out of the hard world and laid it out in its elements upon the table of every class room. Its own masters have known its limitations; they have stopped short at the confines of the physical universe; they have declined to reckon with spirit or with the stuffs of the mind, have eschewed sense and confined themselves to sensation. But their work has been so stupendous that all other men of all other studies have been set staring at their methods, imitating their ways of thought, ogling their results." "Let me say once more, this is not the fault of the scientist, he has done his work with an intelligence and success which cannot be too much admired. It is the work of the noxious and intoxicating gas, which has somehow got into the lungs of the rest of us from out of the crevices of his workshops—a gas it would seem, which forms only in the outer air, and where men do not know the right use of their lungs. * * *" "We have not given science too big a place in our education, but we have made a perilous mistake in giving it too great a preponderance in method over every other branch of study. We must make the humanities human again; we must recall what manner of men we are; must turn back once more to the region of practicable ideals. * * *" "I should fear nothing," says President Wilson, "better than utter destruction from a revolution conceived and led in the scientific spirit."

The chief obstacle to me in my attempt to reach a satisfactory appreciation of President Wilson's point of view lies in his apparently loose and unguarded use

* Address of the Chairman of Section B and Vice-President of the American Association for the Advancement of Science, read at the Washington meeting, December 29, 1902.

of the term 'scientific spirit.' If he means by it that humble spirit of inquiry based upon systematic methods of analysis which are really applicable to the nature of the inquiry, I certainly can not agree with him that it can do any disservice or that it would be anything but a basis of hope as the ruling element in a revolution. I do not believe that President Wilson entertains any such idea. If he means, however, to signify by 'scientific spirit' that widespread and portentous 'neglect of the essential qualities in things,' I most certainly approve his meaning and share his feelings of distress, although I disapprove his mode of expression.

Scientific men are of course not entirely free from this neglect of the essential qualities in things, but I think that the chief neglect lies in the general popular imagination, and I believe that the growth of modern science and the resulting transformations of our material world, have brought upon us an acute and distressing manifestation of it. Inasmuch as I intend to speak to you mainly of the nature and extent of the influence of scientific work on the popular imagination, I may claim to speak on popular science.

We can not discuss intelligently any subordinate manifestation of science until we come to some mutual understanding as to what science itself is; but I must confess that I do not like to go to the extent of defining a thing which, in my own mind at least, is so severely plain and humble. I do not know how you feel, but for my part I am sick of this disgusting din which has been increasing for a hundred years in canting praise of science, a din which I can most easily specify to your perception by saying that my reluctance to define science is chiefly the fear that a pack of popular idiots will rise up with indiscriminate shouting and say—you know, of course, that I have endless choice of ridiculous sayings of influential men in needless and foolish praise of science to quote from! Science does not need praise, nor does work need praise; they both need plain wages. I think it is time to urge a definition of science which will help to purge the popular imagination. Science is the spirit of work. I do not mean the spirit of a man who works, but I do mean simply that science has to do solely with the increasing efficacy of the sweaty labor of this world. I am little disposed to argue what many of you may be inclined to think an undue narrowness in this definition, but I assure you that it is wide enough for me. 'An affected thinker,' says Ruskin, 'who supposes his thinking of any other importance than as it tends to work is about the vainest kind of person that can be found' among busy men.

My own knowledge of science rests partly on anticipation and partly on a college and university experience more than usually varied, and I am convinced that science is 'primarily concerned with the making of breeches,' although, of course, you know and I know many things not now applicable to that useful, or in some cases it may be useless, business. Perhaps one who is chiefly engaged in technical education is prone to accept that practical view, yet one should not, I think, attempt to escape the evidence of one's experience, the less so, indeed, the more intimately his experience is related to practical affairs, and in any case one should only strive against exaggerated inference and extravagant conclusion.

I trust that the granting of my contention as to the severe and unpretentious homeliness of science may not divest it in your minds of a bloom which you deem essential to your interest in it; but however that may be, an understanding of what I have to say demands that much of you.

I hesitate to accept President Wilson's ideal of the perfect place of learning of which he says: 'Calm Science [is] seated there, recluse, ascetic, like a nun, not knowing that the world passes, not caring, if truth but come in answer to her prayer; and Literature walking within her open doors, in quiet chambers, with men of olden time, and calm voices infinitely sweet,' for I fear that President Wilson assumes that the spirit of science is the same as the spirit of literature which is no less a grievous error than to assume that the spirit of literature is the same as the spirit of science. I can not think of science as 'recluse, ascetic, like a nun'; but unquestionably the true seat of learning is a place apart from the world, hedged about by virtue, intrenched in grace and beauty like a woman's womb, its air pure and wholesome with the breath of faith, and looking to heaven for the confirmation of its hope.

I am inclined to look upon science as a servant and I have no sympathy for that state of mind which is exemplified by two extreme types; the man of alleged general culture who has so far forgotten his manhood as to be lost in vacant, staring wonder at the material results of modern science, but who remains in either lazy or stupid ignorance of the underlying method, and the specialist who sighs for those good old days when one man's mind might compass the entire range of scientific activity. This second type is a man who errs mainly in false humility and I am reminded in this connection of the character of Wagner in Goethe's Faust, second part, who humiliates himself before a creature of his own devising, the Homonculus. I take it to be self-evident that science can never transcend the intellectual grasp of a single man. Of course we must remember that as in case of a large industrial establishment there are many details which cannot be carried forward by the superintendent alone, so in science there are many special details which cannot be carried forward by one person, but if we consider rightly, I think it must appear that these details are essentially not intellectual.

Concerning those whose interest in science is based upon its results, I think you will agree with me that no intelligent interest can be so founded. Everything that appears in the name of science in our newspapers and magazines relates only to results. Have any of you seen in our newspapers or popular magazines any detailed description of the principles and methods used by Marconi in his wireless telegraphy? I think you have not, and yet we know too well that there is not a newspaper reader in the country but imagines he has an idea of wireless telegraphy simply because he has read that Marconi has signaled across the Atlantic Ocean!

I am somewhat intimately connected with the teaching of electrical engineering, more intimately, perhaps, than my chief interests warrant, and I frequently have occasion to speak with non-technical men respecting this subject. There are, indeed, many plain men who keep their senses when they speak of the developments in applied electricity and who talk with some degree of rudimentary intelligence concerning these things, but there are many, very many, more who seem to imagine that the glad comfort with which they ride in a trolley car constitutes an intelligent interest in science and has an intellectual quality!

True interest in science begins when one gets an idea into one's head and sees its firm and unequivocal application to external fact, and the characteristic feature of the study of science is a *determining objective constraint upon the processes of the mind.* I am surprised that this one important feature of science study is never

mentioned in the many estimates that have been made of the value of science study in education, for as a matter of fact that complete definiteness which is usually urged as the characteristic feature of science study is the fundamental condition of every psychological process; you say this or you say that, you go or you do not go; and the psychological processes which play in the study of science do not differ from other psychological processes in this respect, absolutely not at all.

Let me illustrate this objective character of science study by an example which happens also to illustrate an error which I suppose many of you entertain. What is the definition of the mass of a body? The careless and imaginative definition which is usually given is that 'the mass of a body is the quantity of matter the body contains.' I suppose that definition satisfies many of you, but it does not satisfy me. All our notions of length and angle take their rise in and are fixed or defined by those fundamental geometric operations of congruence. The real definition of mass is no less a physical operation, the verbal definition is the briefest possible specification of this operation and it can be nothing else, the result of this operation on a given body is an invariant number, and by a feat of the imagination we conceive this invariant number to be a measure of the quantity of matter the body contains. Ask a farmer's boy how he would define or set the boundaries to a cow pasture, explaining to him that you seek real practical information, and I think he could only answer, by building a fence around it! Most of our definitions in physics which apply to sensible things are necessarily applied to ideally simplified conditions which can not be feasibly realized as actual operations, all for the sake of simplicity and directness of statement, and the consequence is, I think, that many of us lose sight of the fact that these definitions are in reality operations.

I sometimes think that no popular scientific writings should be tolerated which do not introduce the reader to some appreciation of the exacting requirements of successful work. Some of Jules Verne's stories, for example, are peculiarly faulty in this respect, and these stories, and many others like them, are largely responsible, in my opinion, for the widespread fancied interest in science on the part of those who really care only for its immediate results. Most persons are fascinated by Jules Verne's care-less trip to the moon and by the easy improvidence of his ten thousand leagues under the sea.

A short time ago I had occasion to review a little book in the pages of SCIENCE, and I found therein an opportunity to briefly state what in my mind is a more serious perversion of science than that which is presented by those whose fancied interest in it is based on its results, and who, poor fools, invest in Keeley motors and sea gold companies because, forsooth, the desired result is so clearly evident. Surely one can not hold the 'scientific spirit' accountable for 'great degeneracies' like these. The book in question purports to treat of the atomic theory, it is prefaced by an introduction by a professor in the University of Chicago, and it deserves a place in DeMorgan's 'Budget of Paradoxes.' I mentioned in my review, to begin with, a list of headings to serve to indicate to the general reader the present scope of the atomic theory; the atomic theory of gases, the theory of crystal structure, the molecular theory of elasticity, the electro-atomic theory of radiation, the corpuscular theory of the electric discharge and of the electric current, stereo-chemistry, and the like, and I expressed it as my conviction that neither the author nor

his introducer knew even a little of these things.

When I take up a book like the one under consideration I am always impelled to ask myself the question, What are atoms? although in studying ordinary books on physical science the question never forcibly occurs to me. In so far as we have anything really to do with atoms, I believe they are mere logical constructions. Bacon long ago listed in his quaint way the things which seemed to him most needful for the advancement of learning. Among other things he mentioned 'A New Engine, or a help to the mind corresponding to tools for the hand,' and I think that the greatest achievement of the nineteenth century in the physical sciences is the realization of Bacon's idea in a great body of useful theory. Helmholtz says: 'It is a great advantage for the sure understanding of abstractions if one seeks to make of them the most concrete possible pictures, even when the doing so brings in many an assumption that is not exactly necessary.' Just how much of this useful theory is to become the common property of all men it is impossible to say. For the theory is by no means fixed and may not be for a century to come, and no one but the most determined specialist can be expected to appropriate and use the more complex theories which depend upon the keenest mechanical sense, the sharpest algebraic faculty, the strongest geometrical imagination, and the most devoted study; but there is a great and growing body of simple conception and theory which can and does represent to the understanding a vast array of fact.

This New Engine, as Bacon calls it, is a necessity to every man in so far as its state of perfection and the limited opportunity for education permits, and on these two conditions no one need fear any serious clogging of men's minds by it. Many scientists do not, however, fully realize, I think, that the great majority of men do not have and should not have any interest, or at least they should not expend their energies, in those border regions of science where uncertainty and obscurity necessarily and prevailingly obtain. The failure of a specialist to realize the remoteness of his work from legitimate popular interest often results in his endeavor to capture the popular imagination by sensational announcements of which we see only too many examples. The fact is that specialization in science requires a degree of renunciation and to the extent that this requirement is not met by scientists they do a disservice to their fellow men. I believe indeed that no man can do honest and effective work as a specialist and fail to meet this fundamental requirement; and the disservice that accrues when he attempts to evade it is illustrated most distressingly by that would-be electro-scientist who has recently telegraphed to Mars!

A career in which one could come into sympathetic touch with great numbers of men would be very satisfactory to most of us, no doubt, but the career of the scientific specialist is not such, and I can not refrain from stating it as my conviction that a sufficiently guarded appropriation of, say, ten per cent. of the income of the Carnegie endowment for furthering the personal intercourse of scientific specialists would be productive of greater results by far than could possibly be effected by the expenditure of the remaining ninety per cent. in any other way whatever. I say this more particularly from the point of view of the western man.

I think, with President Wilson that scientists have, as a rule, recognized the limitations of their work, and I certainly think, also, that other men err in attribu-

ting to science too great an extensity and in failing to reach any just appreciation of the intensity of science. Every one should know that a specialist's idea of a thing, such as a gas, an electric current, or a beam of light, comes very near to being a working model of the thing. The elements out of which such models are made are purely notional, and although the specialist habitually speaks of them in objective terms for the sake of concreteness and clearness, it is of the utmost importance that the thought be chiefly directed to the physical facts which are represented and not to the models themselves. 'Our method,' says Bacon, 'is continually to dwell among things soberly, without abstracting or setting the mind farther from them than makes their images meet,' and 'The capital precept for the whole undertaking is that the eye of the mind be never taken off from things themselves, but receive their images as they truly are, and God forbid that we should ever offer the dreams of fancy for a model of the world.'

There is a tendency among reflecting men to confuse the boundaries between our logical constructions and the objective realms which they represent to the understanding. Münsterberg thinks that this is the gravest danger of our time. I do not fully agree with this, but I do agree with President Wilson in seeing in this confusion of boundaries the effects of a noxious gas which has somehow got into the lungs of other men from out of the crevices of our workshops, a gas, it would seem, which forms only in the outer air and where men do not know the right use of their lungs.

This confusion of boundaries is, to my mind, a new species of idolatry. The old idolatry is the worship of form, and this new idolatry is that contemplation of our logical constructions which despises objective constraint. Now, I can not see that we as scientists are in any degree responsible for this disservice, this working of a great degeneracy among men, but as individuals I think most of us are guilty of more or less frequent and flagrant lapses of that submission to objective constraint which is the very essence of moral quality in scientific work.

An amusing collection of instances of this new idolatry, which we all know is not so very new after all, is given by De Morgan in his 'Budget of Paradoxes.' There are many more of these paradoxes, to use DeMorgan's word for those unconstrained flights of the scientific imagination, in the mathematical and physical sciences than in biology. The explanation of this fact is, I think, that the logical structures of those sciences are to a great extent concrete in character so that even strong minds may lose sight of the boundaries between the realms of the mind and the realms of objective reality. The wide difference between the logical structures of physics and of biology may be further illustrated if I mention that I have long been impressed with the fact that the most satisfactory specialist to talk with is the biologist. His knowledge is not represented to his understanding by a mathematical-mechanical system of conceptions, but it approaches art in its close association with external form. Conversation with a physicist is, however, very like looking into the mechanism of a Mergenthaler type-casting machine, with the machine out of sight, a thing which is feasible enough among designers and builders, but scarcely a satisfactory basis for the flow of thought when one party in the conversation happens to be unfamiliar with and perhaps not interested in the mechanism in question.

Having so far expressed a degree of sym-

pathy with President Wilson in the distress which some of the results of science, direct or indirect, have given him, I wish to say that giving the words of his sesquicentennial address their most sinister interpretation a modern man would infer that President Wilson is inclined to turn back to the hope of a revival of classical and cloistered erudition as the chief end of learning. Now, I think that many of us feel that science itself is threatened by just this sort of thing in its own field. Many of us in fact know so much of the partial knowledges that have been reached during the century that we are deterred from effective work. 'We advise all men,' says Bacon, 'to think of the true ends of knowledge, and that they endeavor not after it for curiosity, contention, or the sake of despising others, nor yet for profit, reputation, power, or any such inferior consideration, but solely for the occasions and uses of life.'

Above all I believe it to be in general a perverting thing to use the elements and results of science as a basis of metaphysical speculation. 'I believe,' with Ruskin, 'that Metaphysicians and Philosophers are, on the whole, the greatest troubles the world has got to deal with; and that, while a tyrant or bad man is of some use in teaching people submission or indignation, and a thoroughly idle man is only harmful in setting an idle example, and communicating to other lazy people his own lazy misunderstandings, busy metaphysicians are always entangling good and active people and weaving cobwebs among the finest wheels of the world's business; and are as much as possible by all prudent persons to be brushed aside like spiders.'

There is, of course, a legitimate sphere of scientific speculation of a certain kind, but the purely suggestive and highly tentative efforts in this line should not be confused with the more substantial work of science, and this is precisely what happens in the popular imagination. The majority of men do not appreciate the difference between a discussion of the motion of stars in the line of sight based upon spectroscopic measurements and a discussion of the habitation of Mars based on nothing at all! Idle speculation is the last infirmity of strong minds, but it is certainly the first infirmity of weak ones, and popular science is, I think, primarily speculation.

The extent to which some of our elementary text-books in physics indulge in weak phases of speculation is very surprising to me for in this connection it is absolutely out of place and entirely misleading. What do you think, for example, of the following quotation from Maxwell as a help to clear up an inadequate definition of energy in a secondary school book in physics? "We are acquainted with matter only as that which may have energy imparted to it from other matter, and which may in its turn communicate its energy to other matter. Energy, on the other hand, we know only as that which in all natural phenomena is continually passing from one portion of matter to another." What do you think of the following from an elementary English text-book? "The fundamental property of matter, which distinguishes it from the only other real thing in the universe, is inertia. * * * We are now in a position to give one or two provisional definitions of matter—provisional because we cannot yet say, possibly may never be able to say, what matter really is. It may be defined in terms of any of its distinctive characteristics. We may say that matter is that which possesses inertia, or again since we have no knowledge of energy except in association with matter, we may assert that matter is the Vehicle of Energy." I

wonder if any of you really doubt that every notion in physics, definite or indefinite, is associated with and derived from a physical operation, and that absolutely the only way to teach physics to young men is to direct their attention to that marvelous series of determining operations which bring to light those one-to-one-correspondences which constitute the abstract facts of physical science. If you do, I am bound to say I do not think much of your knowledge or teaching of physics. I think that the sickliest notion of physics, even if a student gets it, is that it is 'the science of masses, molecules and the ether.' And I think that the healthiest notion, even if a student does not wholly get it, is that physics is the science of the ways of taking hold of bodies and pushing them!

W. S. FRANKLIN.

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*INCOMPLETE OBSERVATIONS.**

IN scientific literature many observations are recorded which, from the experimental proof offered, have been generally recognized as true, but which may be classed as *incomplete*, owing to the fact that the methods of investigation employed destroyed conditions that were later found to exist, or that subsequent discoveries modified the conclusions reached at the time of the original investigation.

As an illustration of this proposition the theories of alcoholic fermentation may be cited. The members of Section C will readily recall the long and bitter controversy which was waged between the two great masters, Liebig and Pasteur, and their respective adherents as to the true cause of this phenomenon.

It is interesting at this time, in the light of recent observations, to compare the two opposing theories.

According to Liebig alcoholic fermentation is caused by the decomposition of complicated nitrogenous bodies designated by him as putrescible material, and the molecular disturbance thereby produced is imparted to the fermenticible substance, sugar, and breaks it up into simpler bodies, alcohol and carbon dioxide.

The vitalistic theory, revived by Pasteur and brought to general recognition by his masterly and convincing experiments, teaches that alcoholic fermentation takes place only in the presence of a living micro-organism known as the yeast plant, and that the phenomenon of fermentation is intimately connected with the life process of this organism. The most convincing proof in support of the vitalistic theory was furnished by Pasteur in his methods of preventing fermentation and allied phenomena by simply heating perishable bodies to a temperature high enough to kill the living germs. In the case of acetic acid fermentation he showed that a temperature of 60° was sufficient to destroy the vinegar plant. At this temperature, he argued, the nitrogenous bodies, which Liebig claimed as the actual ferments, would remain intact. In spite of this, however, he showed that further fermentation was completely arrested so long as living germs were excluded.

Although the work of Pasteur was of the greatest importance to science and humanity, and his experimental evidence for the establishment of the vitalistic theory of fermentation was of the highest order, yet to the minds of many it was never entirely clear that the rival theory was completely overthrown. For a long time, however, the vitalistic theory had clear sailing. But the observations which led to its adoption remained incomplete until a few years

* Address of the Chairman of Section C and Vice-President of the American Association for the Advancement of Science, read at the Washington meeting, December 29, 1902.

ago Buchner startled the scientific world by the announcement that he had produced alcoholic fermentation without the presence of a single living germ. By simply mixing the extract, obtained by strong pressure from brewer's yeast, containing nothing but *dead* organic matter, he caused a solution of grape sugar to ferment, and, in fact, much more rapidly than if the yeast itself had been employed. Not only this—Buchner showed, furthermore, that the activity of this extract was completely destroyed at a temperature below that required to kill the yeast plant. This is the important point in Buchner's observations, because it was the failure to recognize this fact by Pasteur and his adherents that helped, more than anything else, to give the death blow to Liebig's theory. It is true that Liebig at first did not regard his putrescible matter or ferments as a product of the ever-present organisms, and it is also true that in Buchner's extract it is the enzyme of the yeast plant which produces the molecular disturbance that causes the grape sugar to break up into alcohol and carbon dioxide; yet it is gratifying to all those who were students of the great master to learn that, in the main, his attitude toward the process of fermentation has been finally vindicated.

It was the desire of the writer to discuss on this occasion some subject related to that branch of chemistry with which he is at present identified, and for this purpose the investigations in regard to assimilation of free nitrogen by plants were selected for consideration, since this question belongs in the category of 'incomplete observations.'

The importance to agriculture of knowing whether plants were capable of assimilating the free nitrogen of the air was impressed upon the minds of the early investigators of the subject of plant nutrition, because if this element in the free state so liberally supplied by nature should be found to be available as plant food, then it would fall into the same class with carbon, hydrogen and oxygen, which furnish the bulk of all vegetable matter, and about whose source the farmer need have no concern. In the early fifties the French chemist, Boussingault, conducted his memorable experiments with various kinds of plants in order to settle this question. His apparatus consisted of a large glass, one-necked globe, into which he introduced a sufficient quantity of soil freed from nitrogen compounds by ignition. In this soil he planted a certain number of seeds, supplied a sufficient amount of water and then hermetically sealed into the neck of the globe a smaller one filled with carbon dioxide. Under this arrangement the seeds were allowed to germinate and the plants to grow. After a period of several weeks the plants with their roots were carefully removed, dried, weighed and the nitrogen determined. He then determined the nitrogen in a like number of seeds themselves and compared the results. Out of fourteen experiments with various kinds of plants, including the legumes, he found in eleven cases a minus quantity of nitrogen in the plants and in the other three a small plus quantity. The latter results, however, he considered within the limits of errors of observation. His conclusion, therefore, was that the free nitrogen was not available plant food.

At the same time another French chemist, Ville, investigated this problem. His experiments were made on a somewhat larger scale, his apparatus consisting of iron sash filled with glass. Ville uniformly found a marked increase in the content of nitrogen of the plants over that of the seeds, and since nitrogen compounds had been excluded during the time of his experiments, he concluded that the source of

this increase was necessarily the free nitrogen of the air. His objection to Boussingault's conclusions was based upon the claim that, in the confined space in which the plants were forced to grow, their natural development was hindered.

Ville's criticism led Boussingault to repeat his experiments. In order to meet the former's objection to the limited amount of air in which the plants were forced to vegetate, he substituted a three-necked globe for the one employed before. By using an aspirator the air in this globe could be continually renewed, after passing it through a series of Wolf's bottles with the proper solutions to free it from nitrogen compounds. The results of this second series of experiments fully corroborated his former conclusions.

A committee appointed by the French Academy of Sciences to investigate the methods employed by Boussingault and Ville held that, in the latter's experiments, the introduction of nitrogen compounds was not excluded, and, therefore, pronounced in favor of Boussingault. If any doubt had remained in regard to the correctness of Boussingault's conclusions it was dispelled a few years later by the labors of Laws, Gilbert and Pugh. These investigators repeated the experiments of Boussingault with expensive and improved apparatus. Their work was performed with the greatest care and nicety, and their results fully vindicated Boussingault in the position he had taken.

The experimental evidence thus produced in favor of the proposition that the free nitrogen of the air was not available for vegetable growth was so clear and convincing that it was readily accepted by all, with the exception of one man. This man was George Ville, of France.

During all the time in which this opinion prevailed, he alone remained firm in the belief that his observations were true, and that plants could assimilate free nitrogen.

That plants can not assimilate free nitrogen directly was established by those early investigators without a doubt. On the other hand, it is now equally well established that free nitrogen does become available as plant food and plays an important part in vegetable production.

Evidently, therefore, the early investigations must have been incomplete, and at this distant day it is not difficult to point out wherein they were defective. Boussingault and Ville, as well as Laws, Gilbert and Pugh, regarded the soil as a mixture of mineral matter and humus. They had no conception of the fact that it was the home of a world of living microorganisms, which in a variety of ways are silently and incessantly active in the transformation of matter essential to vegetable growth. Hence it is but natural that, in preparation of soil free from nitrogen compounds of all kinds, they should, what any chemist under like conditions would do, subject their soil to an intense heat.

Notwithstanding the prominence of these investigators and the general recognition accorded to their conclusions, further work in this connection was at most only retarded but not entirely abandoned. Facts known at that time, and new observations gradually made in studying the soil in all of its phases, began to point in the opposite direction.

With the discovery of Berthelot, that the fixation of free nitrogen took place through the instrumentality of silent electrical discharges in the soil, were associated the manifold effects upon matter, shown to be due to the action of bacterial life. These latter discoveries may be divided into two groups:

1. Those showing the independent action of bacteria in the soil in causing fermenta-

tion, nitrification, denitrification and fixation of free nitrogen.

2. Those showing the fixation of free nitrogen by microbes in symbiotic relation to higher plants.

The first group of observations including the fixation of free nitrogen in the soil as pointed out by Berthelot and others is of great importance to agriculture, but the amount of available nitrogenous plant food produced by the various processes discovered is not sufficient for the demands of intensive farming. The truth of this statement can be inferred from the fact that, in addition to the enormous amount of nitrogenous material obtained from domestic and industrial sources, as well as from the extensive deposits of guano, there are, at the present time, about one million tons of Chili saltpeter employed annually by farmers the world over to maintain partially the fertility of their fields.

The second group of observations are of greater interest to agriculture, since they point out the way of securing from the free nitrogen of the air an ample amount of combined nitrogen to meet all the requirements of intensive farming. They make the farmer independent of the natural deposits of nitrogenous fertilizers, and furnish him the means of preventing his helplessness, in case these sources of plant food should become exhausted or otherwise unavailable.

From the time of the ancients down to the present day the legumes, especially the clovers, have occupied a unique position among agricultural crops. The beneficial effects of a crop of clover upon subsequent grain crops was a matter of practical experience in ancient and mediæval times, and this empirical knowledge was applied more or less in the practice of agriculture during those periods, as well as in modern times. When the science of chemistry began to shed light upon the production of vegetable matter, and showed the relation which plants, soil and air bore to each other, and especially that certain elements contained in the soil and air were essential to vegetable growth, the peculiar properties of the legumes received early attention. It was soon learned that the leguminous plants were preeminently nitrogen-gatherers. Having accepted the conclusions of Boussingault in regard to free nitrogen as true, the teachers of agricultural chemistry were forced to explain this property of the leguminous plants in various ways. Besides the empirical observations, already alluded to, many comparative experiments were made which showed the beneficial effects of legumes on subsequent grain crops. As an example the experiment of von Wulffen may be cited. One half of a certain field was allowed to remain in bare fallow, while the other half was sown to yellow lupines. After the lupines had fully developed the whole field was plowed and sown to rye. The yield of the two halves was determined separately with the following results:

	Grain.	Straw.
After lupines	532.5 lb	1,072 lb
After bare fallow	322 lb	656.5 lb

Here was a total increase in grain and straw of 626 pounds on that half of the field which had been sown to lupines, while nothing from without had been added to it except sixty pounds of lupine seed. The results of this experiment also show, what was claimed above, that the independent, bacterial activity of the bare fallow fell far short of producing sufficient available plant food for a full crop of rye.

In seeking an explanation for this effect of the legumes, Boussingault determined the amount of refuse, *i. e.*, stubble and roots, left in the soil by various crops. For this purpose he had the roots, etc., collected

from measured plots of fields from which the crops had been harvested. His results are given in kilos per hectare and refer to dry matter. The nitrogen of the refuse was also determined. His figures are given in the following table:

	Crop.	Refuse.	Nitrogen of Refuse.
Wheat	1,002	518	2.1
Oats	1,608	650	2.6
Clover	1,975	1,547	27.9

If it be considered that the essential ash ingredients of plant food are equally high in the clover refuse, it will be seen that the manurial value of the clover refuse is out of all proportion to that of the two cereals, and consequently that clover must be a better forerunner for a grain crop than a grain crop itself. But Boussingault did not stop here. He also collected the refuse matter, roots and leaves from a crop of mangolds, and found that not only the dry matter, but also the nitrogen contained therein, was in excess of that of the clover. Here was a dilemma; for it was well known that, compared to legumes, root crops were poor forerunners for grain crops. The explanation for this apparent contradiction was found in extensive experiments made at Rothamstead. Laws and Gilbert raised root crops on the same field for years in succession without the application of manures, and found that they rapidly exhausted the surface soil. On the other hand, they showed that with clover, even after the removal of a highly nitrogenous crop, the soil was left richer in nitrogen than it was before. It is but fair to state in this connection that other investigators found much larger yields with clover than Boussingault. Thus, to take the other extreme, Heiden obtained from measured plots of clover, after it had become fully ripe, and by removing the whole aerial portion of the crop, the following results, expressed in kilos per hectare:

	Aerial Portion.	Roots.
Dry matter	14,548	8,469.6
Nitrogen	381.5	275.3

Laws and Gilbert, Heiden, and in fact all who investigated this subject explained this large accumulation of nitrogen principally by the assumption that clover, on account of its deep roots, had the power, in a marked degree, of obtaining a large portion of its food from the subsoil and bringing it to the surface. Furthermore, it was assumed that on account of the great leaf surface of clover, its more succulent nature and its longer period of growth, it was capable of collecting more ammonia from the air than was the case with grasses and cereals. Another peculiarity which the legumes were thought to possess was their ability to assimilate, in a higher degree than other crops, the reserve nitrogen of the soil. This assumption would explain, of course, why these plants should make a luxuriant growth on soils on which, for lack of available nitrogen, other crops failed to make a good stand, but it would not throw any light upon the fact, established by general observation, that the total fixed nitrogen of the soil was so materially increased.

It may be truthfully said that all these explanations taken together were not entirely satisfactory to those who were engaged in the teaching of agricultural chemistry, but, in short, this was the status of the nitrogen question for a generation or more, when Hellriegel announced before the section of agricultural chemists of the German Association of Men of Science and Physicians, at their meeting in 1886, that the leguminous plants could assimilate the free nitrogen of the air, and that this assimilation was intimately connected with the nodules appearing upon the roots of

these plants. The hearty applause with which this announcement was received at the meeting, and the widespread and spontaneous interest which it awakened all over the world, showed that it came as a relief to agricultural chemists and vegetable physiologists in general. The report of Hellriegel was based upon observations and experiments made during the four preceding years. He had been appointed jointly with Wilfarth as referee on the subject of nitrogen assimilation by plants. The experiments were made in pots containing four kilos of recently ignited sand, to which the proper amount of mineral plant food, free from combined nitrogen, had been added. The main points established were as follows:

1. When no combined nitrogen was added to the artificial soil the acquisition of nitrogen over that contained in the seeds was naught. This was true for all kinds of plants, including the legumes.

2. The development of all kinds of plants and the acquisition of nitrogen were in direct proportion to the amount of combined nitrogen added.

3. When a small quantity of natural soil, or of an aqueous infusion of such soil, was added to the contents of the pots and no other combined nitrogen introduced, the graminaceous plants, as well as some other families of plants, died of nitrogen starvation and their acquisition of nitrogen was naught.

4. Under the same conditions the leguminous plants, after a period of nitrogen starvation, began to recuperate, the foliage returned to its normal green color, and the plants continued to grow, in some cases vigorously, to complete maturity, and acquired all the nitrogen necessary for this development.

5. The graminaceous plants are dependent upon the combined nitrogen of the soil for their development.

6. The legumes are independent of the combined nitrogen of the soil and can acquire all the nitrogen for their complete development from the air, and, furthermore, not from the small quantity of combined nitrogen contained in the air, but from the *free* nitrogen.

7. Whenever, under these conditions, the legumes acquired nitrogen, this acquisition was invariably accompanied with the appearance of tubercles on their roots.

8. Sterilization of the natural soil or of the soil infusion destroys its effect.

A year later, 1887, Wilfarth made a further report on this subject. In one experiment made by Hellriegel and Wilfarth the classical method of Boussingault was employed. They placed into a large glass globe four kilos of ignited sand, mixed with sufficient water and the necessary mineral constituents of plant food free from nitrogen compounds. They also added a small quantity, an aqueous infusion, of a soil in which peas had been previously grown. In the artificial soil thus prepared they planted a pea, a grain of oats and a buckwheat seed. The globe was hermetically sealed with a ground-glass stopper and the necessary carbon dioxide for the growth of the plants was introduced from time to time. The oat and buckwheat plants grew only till the seeds had become exhausted, and acquired no nitrogen in excess of that contained in the seeds. On the other hand, the pea plant made a vigorous and normal growth and was still growing, when the report was made. A large part of this plant had been removed and was found to contain 6.55 grams of dry matter and 0.137 gram of nitrogen.

This interesting experiment not only corroborates the claims of these investigators, but it completes the original experiment of Boussingault, in that it restores the condition of natural soils, which he had de-

stroyed by his method of removing fixed nitrogen. In this connection it is of interest to refer again to the position on the nitrogen question occupied alone by Ville. It can readily be understood that, in the large apparatus employed by this investigator, the chances for complete sterilization were very remote, especially since no particular attention was paid to this point. Microbes from the soil could easily have found their way into his large case through dust or otherwise, and in the presence of organic matter arising from the seeds and the roots of the plants, could, in a short time, become active in fixing the free nitrogen of the air. The contention of Ville that, in his experiments, free nitrogen of the air was assimilated by plants may, therefore, have been sound.

But to return to the line of thought broken by this digression, Wilfarth reported some important gains in nitrogen by lupines grown in pots with four kilos of nitrogen-free sand on addition of a measured quantity of soil infusion containing not more than seven tenths of a milligram of fixed nitrogen. The yields are as follows:

WITH SOIL INFUSION:

No. 3. 44.73 grms. dry matter with 1.099 grms. nitrogen.

No. 4. 45.62 grms. dry matter with 1.156 grms. nitrogen.

No. 5. 44.48 grms. dry matter with 1.194 grms. nitrogen.

No. 6. 42.45 grms. dry matter with 1.337 grms. nitrogen.

WITHOUT SOIL INFUSION:

No. 9. 0.918 grms. dry matter with 0.0146 grms. nitrogen.

No. 10. 0.800 grms. dry matter with 0.0136 grms. nitrogen.

No. 11. 0.921 grms. dry matter with 0.0132 grms. nitrogen.

No. 12. 1.021 grms. dry matter with 0.0133 grms. nitrogen.

By the sole employment of a small quantity of soil infusion containing an infinitesimal amount of combined nitrogen, in pots holding about eight pounds of sand, the plants made an average gain in dry matter of 42.9 grams, and in nitrogen of 1.18 grams over the same kind of plants grown under the same conditions without this addition. This remarkable result was surely worthy of the general interest which its publication evoked.

Numerous experimenters all over the world at once began to pay attention to the little tubercles, and they were investigated from all points of view. Their morphology was studied by Frank, Laurent and others. For this purpose Frank, as well as Laurent, grew plants partly in water culture with the production of root tubercles. Since their labors belong to the domain of biology this simple reference to them here will suffice.

The results of all investigations from a chemical standpoint verified the conclusions reached by Hellriegel and Wilfarth. But, in addition to this, a great many new facts bearing upon this subject were obtained. Bréal analyzed the nodules of various legumes and found that the content of nitrogen in the dry matter varied from three to seven per cent., and was higher than that of any other part of the plants excepting the seeds. This fact is significant.

Bréal also obtained results similar to those of Hellriegel and Wilfarth by germinating peas between moistened filter papers, inoculating the roots, after they had attained the length of a few centimeters, with a needle which had been plunged into a tubercle, and then growing the plants in nitrogen-free sand containing the necessary mineral ingredients of plant food.

This investigator also grew peas in water culture. After germinating seeds between moistened filter papers as before,

and after the roots had attained a length of three or four centimeters he inoculated them with a needle which had been inserted into a tubercle of alfalfa, and placed two of the young plants in a culture jar, which contained a nutrient solution free from combined nitrogen. The peas grew regularly so long as they found nourishment in the cotyledons. Then a period of nitrogen starvation set in, after which the plants recuperated and grew to maturity with the production of fruit. The period of vegetation extended from April 2 to June 10. At the latter date the roots contained numerous tubercles. The stalks and roots were separated, dried at 110° C. and weighed. The nitrogen of both portions was determined, as was also the weight and nitrogen of two seeds similar to those used in the culture experiments. The following table gives the results:

	Dry Matter, Grams.	Nitrogen, Per Cent.	Nitrogen, Total.
Stalks	3.785	2 35	0.089
Roots	1.165	2.60	0.030
Total	4.95		0.119
Seeds	0.502	3.60	0.018
Gain	4.448		0.101

The table shows that the plants contained ten times as much organic matter and six and six tenths times as much nitrogen as the seeds from which they were derived; also that the percentage of nitrogen of the roots was greater than that of the aerial portion. Now when it is considered that, in this experiment, there was no nitrogen compound of any kind present, except the infinitesimal quantity introduced by puncturing the roots with the needle, and that in two small plants there was a gain of 101 milligrams of combined nitrogen, the claim for the assimilation of free nitrogen must be regarded as established.

The order of leguminous plants, therefore, occupies a unique position in the art of agriculture. The experimental evidence herein submitted shows conclusively why leguminous crops have for ages been recognized as being of special value in maintaining soil fertility, and the discussion of this subject points to the fact that, in many walks and practices of life, empiricism has been in advance of science.

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Ohio State University.

SCIENTIFIC BOOKS.

Glacial Formations and Drainage Features of the Erie and Ohio Basins. By Frank Leverett. U. S. Geol. Survey, Monograph XLI. Washington. 1902. Pp. 802; 26 pl. (maps, sections and views from photographs), and 8 figures in the text. $1.75.

Ohio is the central area described in this report, and it also includes parts of each of the adjoining states and of the Canadian province of Ontario. The great importance and interest of the glacial history of this region, early studied by Whittlesey, Newberry, Orton, Gilbert and N. H. Winchell, and later by Spencer, I. C. White, Wright, Claypole, Chamberlin, F. B. Taylor and many others, is indicated by about five hundred papers cited in a bibliography of twenty pages.

Mr. Leverett enumerates eleven epochs or stages of the glacial period, as follows: (1) The oldest recognized glaciation, called the sub-Aftonian by Chamberlin, perhaps the same as the Albertan of Dawson; (2) the Aftonian interval of recession of the ice sheet; (3) the Kansan stage of glacial readvance; (4) the second or Yarmouth interval of recession; (5) the Illinoian readvance; (6) the third or Sangamon recession; (7) the Iowan readvance, with the principal time of deposition of the loess; (8) the fourth or Peorian recession; (9) the early Wisconsin stage of readvance, with the formation of four successive systems of marginal moraines during the early part of the ensuing recession; (10) the fifth interval of glacial retreat,

with important changes in the outlines and relations of the ice lobes; and (11) the late Wisconsin stage of mainly continued retreat, with ten substages of halt or slight readvance, marked by a series of that number of marginal moraines and changes of the glacial lakes that finally occupied the Erie and Ontario basins. The chief part of the region is covered by the Late Wisconsin drift and its moraines, which in eastern Ohio extend to the boundary of the glacial drift.

Chapter III., filling a sixth part of the volume, treats of the drainage systems, noting in much detail the evidences of great modifications of the preglacial water courses. It is shown that before the ice age probably the upper and middle parts of the present Allegheny River were separately tributary to the stream then flowing along the present bed of Lake Erie; that the lower Allegheny and the Monongahela, with the upper Ohio River in Pennsylvania, flowed also north to the old River Erie by the valley of the Grand River; and that many other changes from the ancient courses of drainage also took place during the glacial period along the Ohio River, thence down to Cincinnati, where the ice sheet at its stage of farthest advance reached across that valley into the edge of Kentucky.

Descriptions of the various drift formations, and especially of the moraines, occupy the greater part of this monograph, which is the second of a series giving the results of Mr. Leverett's extensive field work. The first was published three years ago, entitled 'The Illinois Glacial Lobe,' and he has another in preparation, to treat similarly of the glacial and lacustrine geology of Michigan. His elaborate studies of the ice age in this region of the great Laurentian lakes, abounding with very instructive records of the oscillations and wavering departure of the continental ice sheet, and comprising at last a complex history of many small and large ice-dammed lakes, should be of much value as a basis of text-books for the schools and colleges of these states.

As soon as the recession of the ice sheet caused it to be a barrier on the northeastwardly sloping Erie basin, the water impounded there spread out as a lake, with outlet past Fort Wayne to the Wabash River. Its earliest stage is named Lake Maumee; a later stage, when a lower outlet was uncovered by the glacial retreat, past Ubly, in Michigan, is called Lake Whittlesey; and the still later and most extended stage of this body of water, reaching then into the Huron basin and outflowing, as Lake Whittlesey had done, to Lake Chicago in the southern part of the basin of Lake Michigan, retains the name Lake Warren, which was proposed by Spencer. The shores of these glacial lakes, marked by beach ridges of gravel and sand, have been traced from Fort Wayne east through Ohio, along the Erie shore of Pennsylvania, and to the Finger Lakes and beyond in central New York, where Fairchild has identified the routes of later eastern discharge by which Lake Warren was finally drawn away to the Mohawk and Hudson, being succeeded by the glacial lakes Algonquin and Iroquois in the Huron and Ontario basins.

While the ice sheet was melting away, the land on which it had lain was uplifted from a depression, so that the shore lines of the glacial lakes now have, along great portions of their extent, an ascent to the north and northeast, varying from a few inches per mile to a foot or more, and in some districts, notably east of Lake Ontario, even as much as five feet per mile. At the end of the Iowan stage of glacial advance, the deposition of loess in the Missouri and Mississippi valleys, and of a closely analogous silt formation in the Ohio valley, as described in this report, gives evidence of a depression of these regions probably several hundred feet below their present height. Before the accumulation of the moraines in the Wisconsin stages of general glacial recession, the greater part of the Mississippi and Ohio basins, and the southern part of the basins of lakes Michigan and Erie, had been reelevated to nearly the same altitude that they have since maintained with only slight changes. But after the moraines were formed, and during the existence of the great glacial lakes on the northern borders of the United States, much of their areas yet remained depressed, as is known by the in-

clination of the originally level shores of these lakes.

The latest completed geologic period, when an ice sheet covered the northern half of our continent, is being very satisfactorily investigated, both in the United States and Canada. As in an earlier monograph of this series, on the glacial Lake Agassiz, it will be an advantage to the geological surveys of each country that these detailed explorations about the Great Lakes be extended to give such full description and discussion of the ancient larger lake areas, with their shore lines and relations to the waning ice sheet, on both sides of the international boundary.

Warren Upham.

SCIENTIFIC JOURNALS AND ARTICLES.

Bird Lore for November–December contains articles 'On Journal Keeping,' by Ernest Thompson Seton; 'Flamingoes' Nests,' illustrated, by Frank M. Chapman; 'The Weapons of Birds,' by F. A. Lucas; and 'Whiskey John in Colorado,' by E. R. Warren. The seventh paper on 'How to Name the Birds' is devoted to the Sylviidæ and Turdidæ and the first paper on 'How to Study Birds' are both by Frank M. Chapman. There is the first of a series of portraits of *Bird Lore's* advisory councilors depicting Messrs. William Dutcher, T. Gilbert Pearson, Lynds Jones and C. W. Nelson, and the usual notes, reviews and reports of societies.

The Museums Journal of Great Britain for November has an article on museum matters presented at the Belfast meeting of the British Association, and description of a dust-proof air inlet for museum cases, a feature entirely too much neglected in the construction of cases. F. A. Bather discusses 'Names on the Labels in Public Galleries,' in which he touches on the difficulties of providing so-called common names for objects and intimates that scientific names are much more generally understood than is often supposed. This article should be widely read. There is an interesting series of notes concerning museums in various parts of the world.

The *American Museum Journal* for December gives a summarized account of the proceedings of the Thirteenth International Congress of Americanists, a review of the recent work of the museum, and a list of the December lectures. The number contains the index for Volume II.

The Plant World for October contains 'Extracts from the Note Book of a Naturalist on the Island of Guam,' by W. E. Safford; 'A Study of the Island Flora of the Mississippi River near Sabula, Iowa,' by T. J. and M. F. L. Fitzpatrick, and the second article on the 'Origin of Plant Names,' by Grace S. Niles. Among the shorter articles are the official announcements of the Wild Flower Preservation Society.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 558th regular meeting was held November 22, 1902.

Dr. H. Carrington Bolton presented a paper on 'Science and Art under Rudolph II., 1570–1612,' narrating many of his experiences with the astrologers and charlatans that he patronized so liberally, and pointing out the important results that followed his support of Tycho Brahe and Kepler.

Dr. A. F. A. King read 'Further Remarks on Sunlight, Malaria and Scoto-therapy,' in which he reviewed his former paper (see Science, December 27, 1901, p. 1007), and in support of the blue fluorescence of quinine being its curative property, cited the facts that *esculin* and *fraxin* were also fluorescent and curative like quinine. The curative power of iodine was due to its producing the *violet* iodide of starch in the stomach.

Dr. King recommended blue- or violet-colored clothing for armies in malarious regions, and purple tents instead of the white canvas now used. He suggested several experiments in scoto-therapy—keeping some patients in the dark or in rooms with purple or indigo window glass, and exposing others, nude, to brilliant sunshine—which were inexpensive and easily accomplished, and which, he hoped, those having opportunities would try, in order

to test the power of sunlight in promoting sporulation of malarial parasites in the blood.

Dr. Peter Fireman then spoke on the 'Deduction of the Magnitude of Osmotic Pressure according to the Kinetic Theory.' He held, first, that the mean kinetic energy of the molecules of a dissolved substance is the same as that of a gas at the same temperature; and, second, that the number of impacts of the molecules of a dissolved substance per unit of time on unit area of any imaginary plane in the solution is the same as if the dissolved substance were in the gaseous state and confined in the same volume at the same temperature. Therefore, the laws governing osmotic pressure in solutions are identical with the laws of perfect gases, and follow directly from the kinetic theory.

THE 559th meeting was held December 6, 1902.

Announcement was made of the death of Mr. Henry Mitchell, a distinguished engineer, and of Mr. J. W. Osborne, a distinguished inventor in the art of photolithography, both members of the society.

Professor Newcomb gave a brief account of his visit to Christiania during the past summer to attend the convention of mathematicians held in commemoration of the one-hundredth anniversary of Abel's birth.

The first regular paper was by Dr. C. D. Walcott on 'The Development of the Carnegie Institution.' He pointed out how its location in Washington is a case of natural development, tracing the growth of scientific organization in the city from the early days when this society stood alone, through the times when societies were multiplied, then through the unifying period of the Joint Committee and the Academy of Sciences, out of which came the Washington Memorial Association; by this last-named body plans for research were formulated clearly enough to attract Mr. Carnegie's attention. His $10,000,000 endowment of the new institution is familiar to all. The trustees of this body appointed 16 advisory committees, including 46 members; their reports on projects submitted to them, filling over 200 printed pages, were presented confidentially to the trustees at their recent meeting, together with other reports; portions of these will be made public early next year. Statements were made regarding the principles adopted for making grants, both of exclusion and of inclusion; special emphasis is laid on the selection of the man who is to be responsible for any specific research, since vague or general appropriations are not favored.

Dr. H. W. Wiley, of the Department of Agriculture, in view of the popular interest in his diet investigations, discussed 'How to Test the Harmfulness of Food Preservatives,' if they are harmful, as alleged. He called attention to the enormous industrial importance of the subject, the difficulty of obtaining reliable data, and the danger of complications with foreign countries over our food exports. The older methods of preservation were: Desiccation, resulting in a tasteless product; sterilization by heat, often imperfect, and cold storage. The cold storage plants of the country are worth $100,000,000 and contain constantly food supplies of an equal value. Cheapest of all methods is the use of chemicals. The effect of these may be tested, chemically by artificial digestion, by experiments on the lower animals, or by experiments on man. Under an appropriation from Congress the speaker is beginning experiments on twelve volunteers, whose food supply and excreta will be fully analyzed to determine the effect, if any, of the usual preservatives. Various details of the direct and the control experiments were given.

CHARLES K. WEAD,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

THE 134th meeting was held December 10, 1902. The following papers were presented:

'A Carboniferous Section in the Upper Copper River Valley, Alaska,' by W. C. Mendenhall.

Mr. Mendenhall presented some of the details of a section of 7,000 or 8,000 feet of Upper Carboniferous strata, measured during the past summer among the foothills of the Alaskan Range, in the northern part of the

Copper River basin. The paper closed with a summary of the known Alaskan occurrences of the Carboniferous.

'Occurrence of Paleozoic Rocks in the Southern Portion of the Great Basin Region,' by F. B. Weeks.

Mr. Weeks said in part, the Paleozoic sedimentary series in this region extends from the Pre-Cambrian to the Permian, or possibly the Trias. The granites and allied rocks of the Grand Canyon section, and of southeastern California extending into the Sierra Nevada, comprise the basement complex. The Pre-Cambrian consists of quartzites and schists of undetermined thickness. These are conformably overlain by the Cambrian strata of alternating beds of quartzite, shale and limestone, which attain a thickness of 10,000 feet or more. The Silurian is represented by two great masses of limestone with several hundred feet of quartzite between them. The series is very similar to that described by Hague at Eureka, and the important unconformity between the quartzite and the overlying limestone noted at Eureka also occurs in the Panamint and Grapevine ranges. The Devonian limestone is exposed in the ranges directly east of the Grapevine range, and also forms a considerable portion of the Desert range. The Carboniferous limestones are exposed in the Inyo and Darwin ranges and form a large part of the Charleston mountains. The section in the latter range consists of Lower Carboniferous limestones, red sandstones and shales and an Upper Carboniferous limestone. Above these are other limestones containing a Permian or possibly a Triassic fauna. The data relating to the Charleston range were obtained by R. B. Rowe, who was engaged in a study of the geology of this region for some months prior to his death in 1902. Between the Cambrian and the Ordovician in the Great Basin region there appears to be heavy faulting in some sections, and in others a thrusting of the Ordovician upon the underlying Cambrian beds. Prior to the Carboniferous there was an erosion interval and an overlapping of the Carboniferous upon the Devonian and probably the Silurian. King's conclusion that there are 40,000 feet of conformable Paleozoic strata in the Great Basin region has not been confirmed by recent studies. The structure of the Basin ranges is believed to be the result of crustal movements of uplift and subsidence accompanied by faulting, thrusting and erosion at different stages of Paleozoic time, orographic forms having been modified by erosion and subsequent earth movements during the long interval from the Permian to the present.

'The Horseheads Outlet of the Glacial Lakes of Central New York,' by M. L. Fuller.

Mr. Fuller described the nearly uniform maximum altitude attained by the crests of the drift deposits of the valleys both to the north and to the west of Horseheads, and classed them with morainal terraces rather than with true moraines. The uniform altitude, together with the presence at several points of notches cut to approximately the same level across the projecting rock points by streams flowing along the sides of the ice tongues occupying the lower portion of the valleys, was considered as evidence of a local body of standing water reaching to a height of about 100 feet above the present streams at Horseheads. The terraced character of the outlet at Horseheads was also described, and the opinion expressed that the broader terrace is an erosional and not a constructional (flood-plain) feature, and that it represents the outlet of Lake Newberry at its principal stage. The lower and smaller channel, which is narrower than many of the channels cut by the small streams now existing, is considered as marking the final stage of the outlet when part of the escaping waters of the lake were, as the ice retreated, beginning to escape at other outlets located, it seems most probable, at a point some distance to the east.

Alfred H. Brooks,
Secretary.

TORREY BOTANICAL CLUB.

At a meeting of the club on November 11, 1902, the scientific program consisted of a paper by Dr. L. M. Underwood on 'The Gold and Silver Ferns.' Dr. Underwood said that characters based upon position and form of

sori and indusia have perhaps been emphasized too much in classification; in some species the indusium may be developed or may be wanting on the same plant. There is now a tendency to return to the recognition of the fibro-vascular system as an element in classifying ferns. Mainly free-veined ferns occur in Devonian and Carboniferous remains. Anastomosing veins seem to have developed later; and even now they form the predominant feature in but two of the ferns of our northern states, *Onoclea sensibilis* and *Woodwardia areolata*. The pinnate and flabellate types of venation are very distinct, but are connected in appearance by a modification of the last type with successive alternation of its dichotomy forming a prolonged axis. The ferns known as gold and silver ferns were included in 1811 in the genus *Gymnogramme*. Some twenty genera have since been segregated from it, some of them on insufficient grounds. Many garden hybrids and horticultural varieties have been developed. With the exception of a species in Madagascar, the group is confined to the tropics of America, where the species known as the silver fern is perhaps the most common fern known. The goldenback fern of California is perhaps most familiar to ordinary knowledge; its range is from Alaska to Lower California, but not eastward of the Sierras. In life it is of a bright golden yellow beneath (often replaced by silvery powder), a brilliant green above; in the dry season it coils up involutely, exposing only the under surface, which is covered by its peculiar golden waxy powder.

This and other ferns of the arid region prevent too great transpiration of water by developing waxy or resinous powders, or by layers of wool or of scales. A Mexican species, *Notholæna aurantiaca*, was exhibited, which combines two protections, powder and scales. The silver fern of our arid Southwest finally becomes almost chalky beneath; it becomes coiled almost into a ball in the dry season.

Discussion followed upon the true interpretation of the function of the waxy powder. Dr. C. C. Curtis deemed it to accomplish two purposes, that of plugging stomata and that of reflecting heat. Dr. Rusby recalled the suggestion made by Mr. Chas. F. Cox some years ago, to the effect that plant hairs carry on metabolism and aid nutrition.

Dr. Rusby also described the appearance and habitats of several species which he had been familiar with in Bolivia and in our own Southwest; in the Rockies, where *Notholæna* and *Cheilanthes* grow together from the same crevices of rock, they respond to rain with remarkable quickness. In the dry season when everything else is seemingly dead, if a rain should occur, their coiled fronds quickly become bright green and well expanded, though curled again into little balls in a few days if dry weather follows.

EDWARD S. BURGESS,
Secretary.

NORTH CAROLINA SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE North Carolina Section held its fall meeting in the Office of State Chemist, Agricultural Building, Raleigh, N. C., on Saturday, November 22, 1902, with presiding officer Charles E. Brewer in the chair. Twenty members and visitors were in attendance. Hereafter all papers presented at the meetings will be required to be in abstract. Drs. A. S. Wheeler and G. S. Fraps were elected reviewers for the Section for the ensuing year. Their duties will be for each to prepare and present at some meeting during the year a paper giving briefly the advances recently made in some branch of chemistry. This departure promises to be a valuable addition to the programs. The following papers were presented and discussed:

'Some New Double Sulphates of Lanthanum, and on the Existence of Lanthanum Alums,' by Charles Baskerville and E. G. Moss.

'Lanthanates,' by Chas. Baskerville and G. F. Catlett.

The resemblance of lanthanum to aluminum was taken advantage of and the preparation of such bodies as the lanthanates and meta-lanthanates hitherto not reported, described. The new substances are sodium lanthanate ($NaLaO_2$) and meta-lanthanates of sodium,

potassium, lithium and barium ($M'H_9La_5O_{15}$). Two methods were used—fusion of lanthanum oxide with alkaline carbonates, and prolonged digestion in a very concentrated solution of the alkaline hydroxides at 100° C.

'Studies in Nitrification,' by G. S. Fraps.

The nitrification of ammonium sulphate or cotton-seed meal in a soil under constant conditions is periodic, reaching a maximum and then decreasing, due probably to the variation in the activity of the nitrifying organisms at different times. A sterilized soil, inoculated with different nitrifying soils, nitrifies cotton-seed meal and ammonium sulphate in different ratios, according to the soil used for inoculation, due to difference in the nitrifying organisms. A method is given for comparing the nitrifying power of two or more soils.

'Improved Method for Halogen Determinations in Atomic Weight Work,' by Chas. Baskerville and R. O. E. Davis.

The method reported was devised in the progress of the work on the redetermination of the atomic weight of thorium. The numerous precautions for the determination of chlorine were rehearsed, and attention directed to the deliquescence of thorium tetrachloride and the difficulty incident to complete elimination of chlorine from the dioxidein obtaining the ratio between the halogen and oxygen compounds of that heavy metal. A series of twenty-five preliminary determinations was made of the solubility of silver chloride in pure alcohol, alcoholic solution of silver nitrate, and nitric acid of variable strengths at different temperatures with a time variant. All reagents were the so-called chemically pure.

Elevation of temperature (50° C. and above), excess silver nitrate (more than twenty per cent.), marked acidity (over three per cent.) and prolongation of time of reaction (fifteen minutes) were determined as factors causing a result too high by from .7 to 4.3 per cent. (in exaggerated cases) when a standard sodium-chloride solution was precipitated by a standard silver nitrate. This was due to the formation of aldehyde from oxidation of the alcohol by the nitric acid and silver nitrate, with consequent precipitation of metallic silver with the silver chloride. Experimental proof of this was given.

A new series of six determinations, where all reagents were repurified, silver nitrate being made from metal prepared by the method of Stas, was carried out. Results were obtained giving an error of from zero to .098 per cent., hence it appears that the halogen may be determined accurately when an excess of silver nitrate is used (even to ten per cent.) the solution is slightly acid (nitric), the precipitation being caused at ordinary temperatures with vigorous stirring for five minutes in ethyl alcohol. Proper precautions as to purification of asbestos, using counterpoise crucibles, dark chamber for precipitation and filtration, dark bath for drying, etc.

The use of alcohol appears to be new.

'Chlorides in Tobacco,' by W. H. Pegram. The work set forth in this paper was designed and is being prosecuted for the purpose of ascertaining whether there is a relation between the chlorides in tobacco and the chlorides in the fertilizer used in its production; also whether a high percentage of chlorides (as calcium and magnesium chlorides) affects the hygroscopic property of tobacco, giving abnormal and damaging results at certain stages of its preparation and manufacture. The data are insufficient as yet to justify a valid conclusion.

'Suggested Changes in the Law of Dulong and Petit,' by J. E. Mills. Abstract has appeared in the proceedings of the Elisha Mitchell Scientific Society. (See Science, N. S. Vol. XVI., No. 414, p. 907.)

'Neodymates,' by Charles Baskerville and W. O. Heard.

The following methods were used in efforts to prepare neodymates: Fusion with alkaline carbonates, alkaline earth carbonates and oxides, chlorides, digestion in concentrated alkaline hydroxide solutions, and fusion with sodium dioxide. Results not altogether satisfactory were obtained, with the surprising exception of a barium compound,

$$BaCO_3.Ba(NdO_2)_2.5H_2O.$$

'Artificial Plant Food Requirements of Soils,' by B. W. Kilgore. (See 'Proceedings of the Fifteenth Annual Convention of the Association of American Colleges and Experiment Stations,' pp. 73–75.)

'Methods for the Determination of Total Phosphoric Acid and Potash in Solids,' by C. B. Williams.

The method devised for the determination of total phosphoric acid in soils was simply, after igniting five grams of soil in a platinum dish, treat three times with hydrofluoric acid, evaporating to dryness each time, followed by fusion with ten grams of a mixture of equal parts of sodium and potassium carbonate. The cake thus obtained, after cooling, was transferred to a beaker and digested with about 30 to 40 c.c. (1 to 1) hydrochloric acid, after which the solution was evaporated to dryness on a water-bath, being subsequently heated four or five hours in an air-bath, to 110° C. to dehydrate the silica present. It was then taken up with dilute hydrochloric acid, filtered and washed. The filtrate and washings thus obtained, after adding sufficient nitric acid to liberate all hydrochloric acid present, are placed together and reduced to a volume of about 40 c.c. by boiling. The excess of nitric acid is then neutralized with ammonia, and ten to twelve grams ammonium nitrate is added. After cooling, 30 c.c. recently filtered molybdic solution is added and the phosphoric acid is precipitated by shaking in a Wagner machine, and determined volumetrically (*Jour. Am. Chem. Sc.*, Vol. 23, No. 1, pp. 8–12).

Total potash is brought into solution by treating four grams of soil in a platinum dish on water-bath, after saturating with dilute (1 to 1) sulphuric acid and igniting, with from 2 to 3 c.c. hydrofluoric acid for five times, adding 1 c.c. dilute (1 to 1) sulphuric acid just before going to dryness the last time. After the last traces of hydrofluoric acid have been liberated the dish is removed from water-bath and heated gently over small flame until evolution of sulphur trioxide ceases. The soil is then taken up with 20 c.c. distilled water slightly acidified with hydrochloric acid, and digested on water-bath until the solution has been reduced to about one third of its orginal volume, after which it is transferred to a 200-c.c. graduated flask and heated on water-bath to near boiling, when ammonia and ammonium oxalate are added in sufficient quantity to precipitate all iron, alumina and lime present. After cooling, the volume is made up to 200 c.c., and an aliquot corresponding to two grams is filtered off into a porcelain dish. From this point on the procedure is the same as that prescribed in the regular Lindo-Gladding method.

There being no further business, the section adjourned, subject to the call of the Executive Committee.

C. B. WILLIAMS.
Secretary.

DISCUSSION AND CORRESPONDENCE.

PRESIDENT SCHURMAN ON THE EDUCATIONAL REQUIREMENTS FOR PROFESSIONAL STUDY.

TO THE EDITOR OF SCIENCE: In the issue of SCIENCE of November 21, on page 816, is published an excerpt from the annual report of President Schurman of Cornell University, containing statements bearing upon the question of collegiate work as a requirement for admission to professional schools. It is not my function to discuss or criticize the policy of the President of Cornell University. The report, however, contains several statements upon which comment seems necessary.

"At Cornell University at any rate [runs the report] the established policy is to admit students to any course who are able to pass the examinations qualifying them to pursue that course. And such preliminary tests, it is generally conceded by the members of the profession concerned, do not exceed the requirements for graduation at the best high schools."

I cannot speak for the lawyer, the engineer or the architect, but in the name of the profession of medicine I beg in the most respectful manner to protest. With the matter of culture-studies we need have no concern here. I believe it may be stated as an established fact that a proper education in modern

medicine can not be acquired upon the basis of a high-school preparation. For the adequate study of modern medicine collegiate training in physics, chemistry and biology is essential; to use an academic term, they are prerequisites. How much collegiate training in these branches is necessary is open to discussion; the most general opinion among teachers of medicine is that two years are sufficient. I beg to state that, in my opinion, the majority of the members of the medical profession of this country, as represented in the recognized societies, do not believe that the tests preliminary to medical education need not exceed the requirements for graduation at the best high schools. The teachers of medicine may be said to be almost unanimous in the belief that collegiate preparation in the sciences is necessary for the study of medicine. The majority of the high-grade medical schools have already either inaugurated or announced collegiate requirements for admission; with other institutions the maintenance of the older system is purely a matter of present financial conditions and does not reflect the real policy. These changes have not been made in spite of the profession, but rather with the sympathy and support of the best elements in the profession. In any event, ought it not to be the function of the universities to lead and not to follow the professions?

There is a quite current confusion of two movements. One is the culture requirement for entrance upon professional study; the other is the training requirement. Knowledge of Greek literature, of esthetics, of political science, may be advantageous to the physician, but it is not essential to the study of medicine; knowledge of and training in physics, chemistry and biology of the collegiate type and quality are necessary for the proper study of medicine as it is taught to-day in our best institutions. Departments of medicine are requiring collegiate preparation; in a few instances it may be partly upon the basis of a veneration for general culture, in all instances from the realization of the direct necessity of that training in the natural sciences which colleges alone are able to give. With this adjustment of the prerequisites in science deemed necessary to the study of medicine, the matter of democracy in educational policy, alluded to by both President Schurman and President Hadley, has no concern. The science of medicine has developed to such an extent that it can not be so mastered in four years following a high-school education as to adequately prepare the physician for his duties in life. To extend this course, by prerequisite collegiate work, until it fulfills its obligations to the student and its duty to the public, can not be stigmatized as undemocratic.

ALONZO ENGLEBERT TAYLOR.
THE UNIVERSITY OF CALIFORNIA,
December 1, 1902.

ILLEX ILLECEBROSUS (LESUEUR), THE 'SQUID FROM ONONDAGA LAKE, N. Y.'

THE specimen of squid, the capture of which in Onondaga Lake has been described by Dr. John M. Clarke in a previous number of SCIENCE,* has been sent to the present writer for examination. It proves to belong to the well-known species of our northern Atlantic coast, the 'cold water' or 'short-finned squid.' The specimen has been compared with the description of *Ommastrephes illecebrosus* given by Verrill,† and with two well-preserved individuals (male and female) of this species from Provincetown, Mass., preserved in the collections of the Museum of Biology, J. C. Green School of Science, Princeton University. The result of this comparison is as follows:

Total length of our specimen, from tip of tail to tip of third pair of sessile arms, upward of thirteen inches. Since the largest figure for this dimension given by Verrill is a little over fourteen inches, our individual

* December 12, 1902, p. 947.

† *Ommastrephes illecebrosus* (Lesueur): Verrill, A. E., 'North American Cephalopods,' in *Trans. Connect. Acad.*, Vol. 5, 1880, p. 268, pl. 28. According to the 'Synopsis of Recent Cephalopoda' given by Hoyle, W. E., in 'Voy. *Challenger* Zool.,' Vol. 16, 1886, p. 34, the name of this species stands now as *Illex illecebrosus* (Les.).

is to be regarded as full grown. Other dimensions can not be taken on account of the distorted condition of the respective parts.

Body and head somewhat contorted and out of shape. Skin largely mutilated and worn off. General form agreeing with that of this species. The same is true of the shape and size of the caudal fin, which exhibits the characteristic outline. Details of head normal. Opening of the lids of the eyes widely distended, irregularly circular, anterior sinus indistinct (this is apparently due to preservation).

Sessile arms agreeing in size and shape with this species. All marginal membranes (outside of the suckers) very slightly developed (or worn off), the dorsal and lateral folds of these arms indistinct, and this is especially true of the high median keel of the third arm, of which only traces are seen in our specimen. Owing to the slight development of these keels all the arms appear less angular and more rounded in cross section, although the typical shape is still indicated. Tentacular arms agreeing completely with this species, only the keel on the back side of the club is less strongly developed. Marginal membranes of the suckers indistinct.

No hectocotylization on the fourth sessile arms visible; thus our specimen seems to be a female.

Arrangement, size and structure of suckers of the sessile as well as the tentacular arms agreeing perfectly with Verrill's description and the specimens used for comparison; the only difference I see is that outside of the two rows of large suckers of the club of the tentacles there are only a few smaller ones; but these may in part have been torn off and lost.

The buccal membrane agrees with this species. Color, yellowish-white, with purple chromatophores, but skin largely damaged, so that the usual color pattern is not visible; but the dark blotches above the eyes are well marked. The pen has not been taken out.

To sum it up, our specimen agrees in all essentials with *Illex illecebrosus;* the only differences observed, namely, the wide eye opening, the lack or slight development of the marginal membranes and the keels of the arms, and the absence of some suckers on the tentacles, are no doubt due to preservation and rough handling. That the latter has taken place is shown by the general abrasion of the skin, and the fact that a large number of the suckers have lost their horn rings or are entirely torn off. Similar mutilations and changes are very often observed in ill-preserved cephalopods. Therefore, I arrive at the conclusion that the present individual is in no wise different from *Illex illecebrosus* of our northeastern coasts.*

As to the alleged capture of this species in Onondaga Lake, I can only refer to what Dr. J. M. Clarke says (*l. c.*), and if it is a fact that this species lives in this lake, the only explanation is, as suggested, by a former, post-glacial connection of this lake with the St. Lawrence Gulf. But I am loath to believe that this species *lives* in Onondaga Lake. In this connection I venture only one single suggestion: this squid is largely used for bait, and the capture of squid forms a regular trade on our northeastern coasts. Could it not be possible that somebody has secured by purchase a barrel of squids, to be used as bait at the locality where our specimen was found?

A. E. ORTMANN.

PRINCETON UNIVERSITY,
December 12, 1902.

* This species is abundant from Cape Cod to Newfoundland. Rarely it is found to the south of this range (Vineyard Sound and coast of Rhode Island).

KALLIMA BUTTERFLIES.

TO THE EDITOR OF SCIENCE: Dr. Bashford Dean will find some interesting remarks on the mimicry by this butterfly, and some criticisms of museum representations of it, in an interesting article by E H A 'On the Influence of Mind in Evolution,' *Natural Science,* Vol. IX., pp. 297–302, November, 1896. The main point as regards museums made by this competent observer is that he never saw a *Kallima* sitting with its apparent stalk towards the twig of a tree. On the contrary, it 'always alights head downwards, so as to face anything coming up the tree, which is

much the most likely direction of assault from a lizard.' According to this writer, it is when the butterfly requires to rest that it settles, not on the under side of a leaf, as do most other butterflies, but 'on the bare trunk, or one of the larger boughs, of a tree.'

NAT. SCI.

SHORTER ARTICLES.

DATA WITH A POSSIBLE BEARING ON THE CAUSE OF LIGHTNING.

1. LENARD inferred from his experiments that it is necessary for the water jet to strike a solid obstacle to generate the electricty observed in the surrounding medium of air. I find that a surface of water is also efficient, and I place the electricity as a charge on the water nuclei produced, because the charge increases with the number of nuclei computed from their coronas. In other words, the mere attrition of water by water is sufficient to charge the nuclei.

In a forthcoming paper in the *American Journal of Science* I show that if each nucleus carries one electron, there must be at least 10^6 nuclei per cubic cm. 'At least,' because much of the charge is lost in the tube which conveys the nuclei into the condenser, and I have not yet allowed for this.

From the coronas simultaneously produced I find that about 5,000 nuclei are present per c.c. Hence each nucleus carries 200 electrons, while its potential is below five volts. Thus there are a million electrons in each c.c. of the air which I examine, or in a cubic kilometer there would be 10^{21} electrons, or 7×10^{11} electrostatic units of charge, or about 200 coulombs.

2. Let this region be spherical with a superficial capacity, which would then be $.62 \times 10^5$ cm. The potential* at the surface of the region would be eleven million electrostatic units of potential, or over three thousand million volts, if the nuclei were all of the same sign and were transferred to the surface. Every time the region is emptied of its nuclei, the surface acquires a charge of the enormous potential stated, and there is no reason why the nuclei may not be continually produced by attrition while they are being transferred.

3. Now regarding the transfer of nuclei, we may note that when they are produced from pure water, positive charges are usually in excess; when produced from dilute solutions, negative charges are usually in excess; but I find that the bulk of the nuclei are symmetrically positive and negative.

The velocity of the nucleus of charge e, in an electrostatic field of the potential gradient, E, is $v = Ee/6\pi\mu R$, where R is the radius of the nucleus and μ (.0002, say), the viscosity of air. Put, therefore, in this equation the values which I have here and in other places adduced, $R = 10^{-6}$ cm., $e = 200 \times 7 \times 10^{-10}$ electrostatic units, whence $v = 37$ cm./sec., or over four fifths mile an hour, for the unit electrostatic field; about .003 mile per hour of a field of one volt/cm.

Thus there is considerable mobility in these nuclei. With a strong electrostatic field at least locally in action, the nuclei of one sign would thus be driven outward, warmer nuclei into colder regions of continually increasing conduction or rarer air, where their charges would be dissipated. The other nuclei would be driven earthward, colder nuclei into warmer regions of continually decreasing conduction to be discharged, if at all, by a flash, particularly if, on growth of drops, gravity steps in as a final motor.

Whether there is sufficient commotion in thunder-storms to give rise to the attrition of water, whether comminution will not suffice if accomplished in other ways, whether an earth electrostatic field is an adequately permanent or localized occurrence, whether indeed separation of nuclei is needed if there is enough excess of charges of definite sign, must be left for further consideration; but it seems to me that data bearing on the occurrence of lightning are here suggested which deserve serious scrutiny.

C. BARUS.

BROWN UNIVERSITY,
PROVIDENCE, R. I.

* For a mile flash of lightning 70 coulombs at a million volts are usually conceded (Lodge).

THE HOSTS OF ARGULIDS AND THEIR NOMENCLATURE.

AN excellent monograph of the 'North American Parasitic Copepods of the Family Argulidæ' has been contributed to the Proceedings of the U. S. National Museum by Dr. Charles Branch Wilson and just published. As it is 'the first of a series, now in course of preparation, on the parasitic Copepods,' it seems advisable to point out a defect which should be avoided in the subsequent monographs. The hosts are very often erroneously named or named in a very archaic or contradictory manner. The archaic nomenclature is chiefly connected with foreign forms and is the result of determinations of species made many years ago.

The host of *Argulus nattereri* (p. 720) and *Dolops longicauda* (p. 732) named '*Salmo* (*Hydrocyon*) *brevidens* Cuvier' (p. 720) or '*Hydrocyon* (*Salmo*) *brevidens* Cuvier' (p. 732) does not belong to the same order as *Salmo* nor to the same genus as *Hydrocyon* (which is confined to Africa), but to a genus (*Salminus*) peculiar to South America. The *Argulus salmini* (p. 720) was also found parasitic 'in the gill cavity' of *Salminus* and not of '*Salmo*,' a genus, as already stated, of a different order.

Species of '*Chromis*' are designated as the hosts of two species of Argulids, *Argulus chromidis* of Nicaragua (p. 721) and *Chonopeltis inermis* of Wiedenhafen, East Africa (p. 729).

Probably the Central American fish is a Cichlid of the genus *Heros*, and the East African, one of the genus *Tilapia*. *Chromis* is now reserved by all the best authorities for a salt-water genus of the family of Pomacentrids.

The host of *Argulus doradis* called *Doras niger* (p. 734) is now known as *Oxydoras niger*. The host of *Argulus africanus* (p. 727) called *Claria* is a catfish of the genus *Clarias*.

The host of *Dolops reperta* of Guiana (734) called '*Aymara*' is an Erythrinid now known as *Macrodon tareira* or by the earlier but extremely inappropriate name *Macrodon malabaricus*, due to a blunder of Bloch committed more than a century ago.

The host of *Dolops striata* (p. 735) and *Dolops bidentata* (p. 736) of Guiana, called 'a species of *Anguilla*,' is probably a species of a different order named *Synbranchus marmoratus*. No *Anguilla* has been recorded from Guiana.

The host of *Dolops discoidalis* designated as a species of *Platystoma* has been for nearly forty years universally called *Sorubim*.

Another fish, the common alewife, on the same page is called *Clupea vernalis* and *Pomolobus pseudoharengus*.

Dr. Wilson's bibliography is well digested, but he seems to have overlooked a few articles. Among such are three of minor importance by Reinhardt (1864), Frauenfeld (1870) and Dambeck (1877), besides one of considerable importance by von Nettovich (1900) of thirty-two pages and two plates.

One other defect should be remedied. No habitat except 'Wiedenhafen' is given for *Chonopeltis inermis*. As Wiedenhafen is not noticed in current gazetteers (it is not in the latest edition of Lippincott's) it was deemed necessary to refer to the original description but the only reference to the place of description was 'Thiele, 1901,' the rest of the line sufficient for the page being left blank. On reference to Thiele's article in the *Zoölogischer Anzeiger*, it appeared that Wiedenhafen is in East Africa. The name of the host is no guide.

The other lapses are not of sufficient importance to demand special attention here.

THEO. GILL.

COSMOS CLUB.

THE GREAT NEED IN AMERICAN ZOOLOGY.

AT the present day the zoologists of the United States of America can point to a considerable number of well-equipped laboratories, and of others in course of construction; of libraries, such as that of the Philadelphia Academy of Natural Sciences, which is probably not excelled; of an annually increasing number of fellowships and free scholarships to enable students to investigate; and of the aid of the government in maintaining such

institutions as the National Museum. Universities are growing richer, for which we are thankful, and more numerous, an evil necessary perhaps to the geographical extent of the country. There are great reference museums in Philadelphia, Washington, Boston, New York, Chicago, and others with a good promise that have been more recently started. These are surely signs of a vigorous activity in research, and we all must rejoice in them.

It is not buildings, nor endowment funds, nor libraries nor collections that make laboratories or universities or museums, but it is the men who do constructive work in them, those who discover and classify the facts. There have been examples of institutions that might have been splendid, but which have proved to be only ornate, and because capable men have not been placed in untrameled guidance of them they have proved to be melancholy mausoleums, examples of a donor's folly. They have had their use in the general economy of things, however, for they have taught the American public that men, and not buildings, mean greatness—the men who do the work for the love of it and without thought of personal advancement.

But the work that is being accomplished, the zoological investigations and reflections, what is being done to give it publicity? By no means all that should be done. The avenues of publication are incommensurate with the amount of the investigations. For we see nearly annually papers by Americans published in the English *Quarterly Journal of Microscopical Science,* in Spengel's *Zoologische Jahrbücher,* in the *Archiv für Entwicklungsmechanik,* and in the two *Anzeigers.* America builds and maintains laboratories in sufficiency, but does not afford to publish all the work done in them. One hesitates to undertake an elaborate contribution, particularly one with expensive illustrations, for when an American journal has at last been persuaded to accept it, great delay is experienced before its final appearance, and by the time the proofs are received they seem like an old and stale story. So we are obliged to advise our students to condense their doctor's theses, to omit colored drawings, even to use the pen in place of the pencil, in order to avoid the expense of lithography. Now any one at all conversant with the nature of zoological investigation understands how important for the representation of the facts are good and numerous figures; so important, that the zoologist is involuntarily inclined to estimate the truth of the facts contained in a paper by the character of the drawings, these being the concise evidence of what the describer has seen, or of what he thinks he has seen. The number of illustrations should in no case be reduced; in most cases they should be considerably increased, and as far as the mere statement of facts is concerned the illustrations should preponderate over the text. More thought goes into the making of a drawing than into the writing of a purely descriptive text, and much more technique. There would be much less confusion in descriptions, consequently much less also in conclusions, if writers had not been obliged to be sparing with their drawings, but every American editor shrinks before an offering of drawings. A certain German cytologist, as it will be recalled, sent out with each author's reprint of a paper upon cellular 'Elementarorganismen' a small ribbon of paraffine sections of the objects that he described, with the request that each recipient mount these sections, study them, and so be convinced of the writer's truth. That is a method of argument, however, that is generally not feasible; duplicate material cannot be furnished to all who are interested in a subject, but good drawings and plenty of them should be furnished, regardless of the expense of reproduction.

Plainly, what we need, and it is now the first need of zoological research, are ample means for publishing large monographs accompanied by numerous detailed plates, and for publication of them as rapidly as the plates can be reproduced. Our present journals are mainly the proceedings, transactions and memoirs of societies and universities, and the government publications; there are a considerable number of these, and some of them offer excellent facilities. Then there are a

few independent journals for general zoological papers, such as the *American Naturalist* and the *Biological Bulletin*, both intended for shorter contributions; and the more recent *Journal of Anatomy*, which is limited, however, mainly to vertebrate anatomy. Foremost among the independent journals is the *Journal of Morphology*. It has done its duty nobly; we are proud of it and ready to maintain it; but it should have two or three volumes a year, instead of a single one, and as many more as may be necessary.

That these avenues of publication are far from sufficient for the amount of investigation is shown by the fact, already mentioned, that a large number of American papers are being published abroad, and that American editors are obliged to insist upon small volume of text and paucity of illustrations. Occasionally a Mæcenas has come forward and made possible the publication of a large work; but obviously investigation cannot depend upon such sporadic aid. Contrast our relatively small number of journals with those in Germany. There, in addition to the publications of societies, which are more numerous than our own, and some of them much more sumptuous, are a large number of independent journals: the *Anatomischer Anzeiger*, *Zoologischer Anzeiger*, *Biologisches Centralblatt*, and others intended for shorter papers; and for larger monographs the *Zeitschrift für wissenschaftliche Zoologie*, *Archiv für mikroskopische Anatomie*, *Morphologisches Jahrbuch*, *Jena'ische Zeitschrift*, *Zoologische Jahrbücher*, *Anatomische Hefte*, *Ergebnisse der Anatomie und Entwicklungsgeschichte*, *Archiv für Naturgeschichte*, *Archiv für Protistenkunde*, and others. America can make absolutely no comparison with that array, which includes only the more notable journals. France and Austria also outdo us in facilities for publication.

To our shame it must be said that our avenues of publication by no means keep pace with the increase in work of investigation. It is not a new fact; it is a case of bringing owls to Athens to recall this state of affairs to the readers of SCIENCE. But the condition of apathy that has existed in regard to it needs to be replaced by one of activity. There are rich men who can financier our zoological publications if the matter be brought to their attention in the right way; an ample endowment fund for large monographs, safeguarded by a competent board of critical editors, is not chimerical, but entirely feasible. The society should feel itself honored by the tender of a good monograph, and not the author by its acceptance for publication; good work should not go a-begging. There should be a concerted attempt to strengthen all the present journals, by increasing already existing publication funds and by multiplying the number of subscribers. Can not the matter be so presented to rich men that they may see an endowment fund for publication is of greater service than the founding of a university? Few men are so made that they have so much delight in the discovery itself, that the charm is not enhanced by making it known to others; obstacles in the way of publication, such as there are to-day without need, may do much to dishearten research.

One word of warning must be said: we do not need new journals, but a financial strengthening of those that we already have. And because, first, we owe support to the journals that have stood by us; second, because concentration is wiser than extensification, and, third, because a new journal, whose name has not yet become known, means practical burial for the papers contained in its earlier issues.

THOS. H. MONTGOMERY, JR.
UNIVERSITY OF PENNSYLVANIA.

THE BISHOP COLLECTION OF JADE AND HARD-STONE OBJECTS.

HEBER R. BISHOP was born March 2, 1840, at Medford, Mass., and died in New York City, December 10, 1902, at the age of sixty-three years. Mr. Bishop recently presented his famous collection of jade and hard-stone objects to the Metropolitan Museum of Art, New York City, and gave the sum of $55,000 for its installation in suitable cases, to be made in Louis XV. style by Allard, of Paris, one of the leading artisans of France.

And if this is not enough his estate will add to this.

A special hall will be set aside for it, to be known as 'Bishop Hall,' where it will be displayed in the finest solid gilt-bronze, plate-glass cases, but it will not be upon exhibition until a year from this time.

This is the finest collection of jade objects, engraved and jeweled, that exists in any public museum or private collection. It numbers more than one thousand specimens and fully represents all phases of the artistic development of this interesting material. The collection was started by the purchase of the Hurd jade vase from Messrs. Tiffany & Co., in 1878. This was one of the finest pieces that ever left China, and led to Mr. Bishop's taste for collecting such objects.

The collection will be described in a volume, which when published will probably be one of the most remarkable, expensive and sumptuous books ever issued, limited to an edition of one hundred copies.

Nearly ten years ago, Mr. George F. Kunz began the preparation of a mineralogical, geological and archeological description of the collection, to be published in this great catalogue, upon which Mr. Bishop had expended more than $100,000 at the time of his death. The scientific investigation was given entirely to Mr. Kunz, and he associated with him about twenty of the most eminent men in various related lines upon both sides of the water; and a more thorough investigation of this mineral has been made than was ever perhaps undertaken upon any other known mineral. The specific gravity, the tensile strength, the compression test, the sonorousness of the mineral from a musical point of view; a chemical investigation, a microscopical study, a microscopical examination of the thin sections; the origin of the mineral, the mining, the archeological history; the cutting, drilling, polishing, and many other phases, were gone into most thoroughly; and where a specialist existed who more minutely understood any special branch, he was called upon by Mr. Kunz to carry out the work.

The volume upon publication will go only to public institutions. The foreign etchings by French and Chinese colonists are unequalled. Many of the color illustrations are by Prang, who made those in 'Gems and Precious Stones of North America,' so well known by our readers. It was this work that suggested the color illustrations for the Bishop book on Jade, as well as for the magnificent Walters book on Chinese porcelains.

SCIENTIFIC NOTES AND NEWS.

The Nobel Prizes, if the statement now cabled from Sweden is correct, have been awarded as follows: *Medicine,* Major Ronald Ross, of the School of Tropical Medicine, Liverpool. *Chemistry,* Professor Emil Fischer, of Berlin. *Physics,* divided between Professors Lorenz and Zeemann, of Holland.

The Cambridge Philosophical Society has elected as honorary members Professor H. F. Osborn, Bayley Balfour, A. H. Becquerel, E. Fischer, Richard Heymons, J. H. van't Hoff, M. Jordan, W. K. von Röntgen, Corrado Segre and Hugo de Vries.

Mr. Philip MacMillen, director of the Queensland Botanic Garden at Brisbane, has been elected a corresponding member of the Royal Botanic Society of London.

W. H. Osgood, of the U. S. Biological Survey, has just returned from a biological exploration of the base of the Alaska Peninsula and the region between Lake Clark and Nushagak River. This work is in continuation of his previous explorations of the Yukon River and Cook Inlet regions, the results of which have been already published in North American fauna.

Professor J. C. Arthur has been granted a month's leave of absence by the authorities of Purdue University, and will spend January at the N. Y. Botanical Garden in researches on the genera of the Uredineæ and their types.

Dr. M. A. Howe, assistant curator of the N. Y. Botanical Garden, has returned from a six week's collecting trip along the coast of Florida, bringing a large number of specimens of the algal flora of the Keys. Professor

F. S. Earle, assistant curator, returned from Jamaica on December 2. During his tour on the island of Jamaica an investigation was made of a number of diseases of the economic plants and a large collection of fungi was made.

MR. HANBURY, fellow of the Royal Geographical Society, reached Winnipeg on December 15, after an absence of nearly two years in the Arctic circle and the Hudson's Bay regions.

As has been fully reported in the daily papers, Mr. Marconi has established communication by wireless telegraphy between Cape Breton and Cornwall. His announcement, dated December 21, is as follows: "I beg to inform you for circulation that I have established wireless telegraph communication between Cape Breton, Canada, and Cornwall, England, with complete success. Inauguratory messages, including one from the Governor General of Canada to King Edward VII., have already been transmitted and forwarded to the Kings of England and Italy. A message to the *London Times* has also been transmitted in the presence of its special correspondent, Dr. Parkin, M.P."

DR. W. B. WHERRY, associate in bacteriology at the University of Chicago, has received an appointment to the post of bacteriologist in the Government Laboratories at Manila, P. I.

DR. DAVID T. DAY, chief of the Division of Mineral Resources of the U. S. Geological Survey, has been elected a member of the board of managers of the National Geographic Society to fill the unexpired term of Mr. Henry Gannett. As Mr. Gannett will remain in the Philippines for a year or more, engaged in the census of the islands, he has resigned temporarily from the board.

THE first Livingstone gold medal has been awarded by the council of the Scottish Geographical Society to Sir Harry H. Johnston, G.C.M.G., K.C.B., for his distinguished services as an explorer and administrator in Africa.

MR. EDMUND PERRIER has been elected as the representative of the Paris Museum of Natural History on the French Council of Public Instruction.

DR. J. B. DETONI has been appointed professor of botany and director of the Botanic Gardens at the University of Modena.

PROFESSOR G. W. GREEN, professor of mathematics in the Illinois Wesleyan University, has died at Bloomington, Ill., at the age of forty-five years.

WE learn from the *American Geologist* of the death of Mr. R. A. Blair, at Sedalia, Mo. He had spent many years in studying the rocks of central Missouri, and had made valuable collections from the Chouteau limestone.

THE death is announced of Dr. J. Wislicenus, professor of chemistry in the University at Leipzig.

PRIVY COUNCILLOR VON KUPFFER, professor of anatomy at Munich, died on December 16.

WE regret also to record the deaths of Dr. Friedrich Rüdorff, formerly professor of inorganic chemistry at the School of Technology at Charlottenburg, at the age of 70 years; of Dr. Wladislaw Celakowsky, professor of botany at the German University at Prague, at the age of sixty-seven years; of Dr. Latschinow, professor of physics and meteorology in the School of Forestry at St. Petersburg; of M. Dehérain, professor of vegetable physiology in the Paris Museum of Natural History; of M. Hautefeuille, mineralogist in the Faculty of Sciences at Paris, and of M. Millardet, professor of botany at Bordeaux, known for his researches on phyloxera.

THE Board of Trustees of the Carnegie Institution has made an appropriation of $8,000 for the establishment and maintenance of a desert botanical laboratory for the fiscal year 1902–1903, and the executive committee of the institution has appointed Mr. Frederick V. Coville and Dr. D. T. MacDougal an advisory board in relation to this undertaking. The proposed laboratory has been established for the purpose of making a thorough investigation of the physiological and morphological features of plants under the unusual conditions to be found in desert regions, with particular reference to the relations of the char-

acteristic vegetation to water, light, temperature and other special factors. A resident investigator to be placed in immediate charge of the laboratory will begin a series of researches upon certain more important problems outlined by the board, and facilities will be provided by the aid of which a few other investigators from any part of the world may carry on work upon any problem connected with desert plants. A discussion of the scope and purposes of the laboratory was arranged to be given before Section G at the Washington meeting of the American Association.

The Convocation of Oxford University has authorized a grant of £100 from the Craven Fund to Mr. David G. Hogarth, M.A., fellow of Magdalen, in aid of researches and exploration at Naucratis.

The Thomson Foundation Gold Medal of the Royal Geographical Society of Australasia, Queensland, will be awarded to the author of the best original paper (provided it be of sufficient merit) on each of the following subjects, the papers to be sent in by the date named: (1) The commercial development, expansion, and potentialities of Australia; or, briefly put, the commerce of Australia (July 1, 1903); (2) the pastoral industry of Australia, past, present, and probable future (July 1, 1904); (3) the geographical distribution of Australian minerals (July 1, 1905); (4) the agricultural industry of Australia (July 1, 1906).

We learn from the *Botanical Gazette* that Pearson's collections of Hepaticæ have been secured by the National Herbarium at the British Museum. It contains about 9,000 specimens, among which are many types and the material used in preparing several well-known papers.

A civil service examination will be held on January 27 for the position of assistant biologist in the Department of Agriculture, at a salary of $1,200. The subjects and weights are as follows:

Geographic distribution of animals	20
Mammals	20
Birds	15
Geography of North America	10
Taxidermy	10
Field experience in biological investigation	15
General education and training	10

On the same day there will be held an examination for the position of botanical clerk in the National Museum at a salary of $600. The scientific part of the examination is on systematic botany. On January 29 and 30 there will be held an examination to secure an eligible list of physicians in the United States and Philippine services. The scope of the examination is as follows:

Thesis (500 words to be written on one of two topics given)	4
Correction of rough-draft manuscript (250 words)	3
Mathematics (arithmetic, algebra, including quadratics, and plane geometry)	3
History and civil government of the United States	3
General history and geography	2
Colonial government and administration (general questions)	2
Political economy (general principles)	1
Education and experience	2

Optional examinations may at the same time be taken in most of the sciences. Candidates are particularly desired for positions in chemistry, engineering and agriculture in the Philippine service at salaries from $1,200 to $1,400.

Reuter's Agency is informed that the suggestion that the British Association should hold its annual meeting for 1905 in South Africa emanated from the new South African Association of Science, of which Sir D. Gill, Astronomer Royal for the Cape, is president. Before the last meeting of the British Association at Belfast invitations were sent from the municipalities of Cape Town, Kimberley, Bulawayo and other centers in South Africa, and it is understood that these have been accepted, and that the session of 1905 will be held in South Africa. Scientific papers will be read at various centers in the South African colonies, and visits will be paid to numerous places of interest. A sum of £7,000 has been collected in South Africa for the entertainment of the Association. While in Rhodesia the visitors will be the guests of

the Chartered Company, who will place their railways at their disposal, and, among other things, take them by special train to the Zambesi, where they will stay at the new hotel to be erected near Victoria Falls. Probably the guests will leave England in a special steamer.

THE second International Congress of Mathematicians will be held at Heidelberg in 1904.

THE Association for Promotion of Scientific Research by Women announces that applications should be received before March 1 for the American Women's Table at the Zoological Station at Naples. Application blanks for the use of candidates, items relating to the expense of living at Naples, and full information as to the advantages for research at the station may be obtained from the secretary, Miss Cornelia M. Clapp, Mount Holyoke College, South Hadley, Mass.

THE House of Representatives has passed the pure food bill introduced by Mr. Hepburn; it provides "for preventing the adulteration, misbranding, and imitation of foods, beverages, candies, drugs and condiments between the States and in the District of Columbia and the Territories, and for regulating inter-State traffic therein." It directs the Secretary of Agriculture to organize the chemical division of the Department of Agriculture into a Bureau of Chemistry, which shall be charged with the inspection of food and drug products, and shall from time to time analyze samples of foods and drugs offered for sale. Traffic in adulterated or misbranded goods is prohibited under penalty of a fine not exceeding $200 for the first offense, and for each subsequent offense a fine not exceeding $300 or imprisonment not exceeding one year or both.

AT a meeting of the Zoological Society of London on November 18 Dr. Forsyth Major read a paper on the specimens of the Okapi that had recently arrived in Brussels from the Congo Free State. The author stated that these specimens, whilst presenting the same specific characters as the specimens formerly received by the Congo State authorities, showed conclusively that the male was alone provided with horns, and that the mode of their development was the same as in the Giraffe. The Okapi seemed to be a more generalized member of the Giraffidæ than the Giraffe, sharing not a few features of alliance with the Upper Miocene *Palæotragus* (*Samotherium*). In several characters it was intermediate between the Giraffe and the fossil forms; but, apart from these, some features were pointed out in which it appeared to be even more primitive than its fossil relatives. These last characters went some way to support the assumption that Africa was the original home of the Giraffidæ.

THE London *Times* states that the official decision of Germany to take part in the Universal Exposition to be held in St. Louis in 1904 has long been assured. The delay in making the announcement has been due wholly to the exigencies of the domestic situation, and to the depression in business prevailing during the past two years. In fact, after the visit of Prince Henry to St. Louis, the tender by the Emperor of a statue of Frederick the Great to the city of Washington, and the changed attitude towards the Monroe doctrine, recently apparent, participation on large lines was certain. These have been an earnest of the emperor's desire to please and conciliate the Americans upon both the diplomatic and personal sides. High politics has, however, been only one of the influences behind this decision. The principal idea has been that of broadening the demand for German wares, with the result that there is general concurrence in the opinion both as to the necessity and the helpfulness which come from the most perfect and varied displays at all the great exhibitions. Even that at Paris in 1900 was striking, following, though it did, the failure to exhibit there at all in 1889. The great Krupp firm, which has so distinctly been built up to its present massive proportions by the policy inaugurated at the Great Exhibition of 1851 and since maintained without interruption, has really been the one potent example. At the Chicago Exhibition of 1893 Germany expended about $800,000 upon its

buildings, its official display, and as an aid to the manufacturing and commercial features. Thus far no announcement has been made of the sum likely to be set aside for use at St. Louis, but, from assurances given by the emperor, that for the purpose of illustrating every phase of its artistic, manufacturing, agricultural and industrial development Germany would make at St. Louis the finest exhibit ever shown from that country, the conclusion has been reached that at least 4,000,000 Marks will be set aside for this purpose.

Mount McKinley, the highest mountain on the North American continent, was visited last season by Alfred H. Brooks and his party from the United States Geological Survey, of which Mr. D. L. Reaburn was topographer. As far as is known, this is the first time the slopes of the peak have been reached by white men, though in 1898 its altitude and moisture were determined from a distance by Robert Muldrow, of the same survey. The mountain is located near the western margin of the Alaskan Range, the general name given to the large mountain mass which separates the Yukon and Kuskokwim waters from Cook Inlet drainage. It is a great dome-shaped mountain, formed of intrusive rock, towering to an elevation of over 20,000 feet above the sea level. Though its summit reaches so high an altitude, almost four miles above tide, it probably is not as difficult of ascent as some other Alaskan mountains, for example, Mount St. Elias, because of its relatively high snow line. As the season was well advanced, as much of his itinerary had still to be carried out, and as it was no part of the original plan, Mr. Brooks did not attempt to pass the snow line, though this point was reached. Now that the location and height of the mountain have been established by the exploration of the Geological Survey, travelers and individual explorers will doubtless soon attempt to reach the summit. In anticipation of these attempts, Mr. Brooks is preparing a description of the country, giving routes by which the mountain may be reached and other information valuable to those interested in its ascent. His paper will appear in one of the leading geographical magazines. The more elaborate and extended report of the exploration will be published by the Geological Survey at an early date.

UNIVERSITY AND EDUCATIONAL NEWS.

It is announced that during the past two years an endowment fund of more than $1,000,000 has been raised for Syracuse University.

By the will of the late Mrs. Lura Courrier, of New York City, Yale University will ultimately receive $50,000 for the aid of poor students.

Northwestern University will celebrate its founder's day on January 28, when its new professional school building, costing over $900,000, will be dedicated. President Hadley, of Yale University, will deliver the dedicatory address, taking as his subject, 'The Place of the Professionl School in the Modern University, and its Relation to the Other Departments.'

The electrical laboratory of the Rensselaer Polytechnic Institute at Troy, N. Y., has been almost completely destroyed by fire. The loss is estimated at over $30,000.

We learn from *Nature* that the reader in geography and the lecturers in ethnology and geology of Cambridge University have arranged for a series of lectures and practical courses to serve as a training for persons wishing to undertake exploration or desirous of contributing to our knowledge of foreign countries. The series will be held during the Lent term, and will include history of geographical discovery, principles of physical geography, map-making and map-reading, geography of Europe, by Mr. Oldham; anthropogeography, practical ethnology, by Professor Haddon; geomorphology and geology, by Mr. Marr; plane-table and photographic surveying, by Mr. Garwood, and elementary astronomical surveying, by Mr. Hinks.

Kenyon K. Butterfield, instructor in rural sociology at the University of Michigan, has been appointed to the presidency of the Rhode Island State College of Agriculture, at Kingston.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 9, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE fifty-second annual meeting of the association, which was held in Washington, D. C., from December 29 to January 3, was noteworthy in many respects as marking the passage to a new order of things in the position and conduct of the association. The total enrollment reached 989, which is second to that of the Boston meeting in 1880, when 997 were enrolled, and to that of the second Philadelphia meeting in 1884, when 1,261 enrollments appear. Of these, however, 303 members of the British Association represent complimentary enrollments. The geographic distribution of the members in attendance was as follows:

District of Columbia, 354; New York, 133; Massachusetts, 82; Pennsylvania, 70; Ohio, 39; Maryland, 38; Illinois, 27; Connecticut, 23; Michigan, 22; New Jersey, 19; Wisconsin, 19; Indiana, 16; Virginia, 14; North Carolina, 13; California, 12;

New Hampshire, 10; Missouri, 8; Canada, 8; Nebraska, 7; Minnesota, 7; Vermont, 6; Rhode Island, 4; Tennessee, 4; Kentucky, 4; Iowa, 4; Florida, 3; Maine, 2; West Virginia, 2; South Carolina, 2; Georgia, 2; Texas, 2; Montana, 2; Colorado, 2; Delaware, 1; Wyoming, 1; Arkansas, 1; Mississippi, 1; Kansas, 1; South Dakota, 1; Alabama, 1; New Mexico, 1.

Foreign attendance: Canada, 8; England, 1; Ceylon, 1; Nicaragua, 1.

In addition to these, 363 members of affiliated societies also registered at the office of the association, so that the total enrollment of scientific men in attendance at the meetings was 1,352, and the total attendance may be conservatively estimated as not less than 1,500.

The membership of the association, which had reached at the Pittsburgh meeting a total of 3,473, was augmented by the election at this meeting of 392 additional persons. One may assert with reasonable confidence that the gathering was the most representative and extensive which has ever been held under the auspices of any purely scientific association in this country and stands in favorable comparison with any similar congress in other lands. This was undoubtedly due in part to the advantages of Washington in accessibility and attractiveness, as well as to the large number of affiliated societies which cooperated in the gathering. One may well affirm that the experiment of changing the time of meeting has proved a distinct success, and this is evident not only in the size of the gathering but in the characteristic features of the series of meetings as well.

In the first place, it was noteworthy that the attendance was composed in great majority of the working scientific men of the country. The meetings of the various sections were well attended and the spirit of the sections was one of work, most gratifying to those who look for renewed scientific interest and activity as a result of the change in policy of the association. It is further noteworthy that the number of affiliated societies has been increased by the addition of many of the permanent scientific organizations of the country. Such an assemblage could not be made without numerous and even serious conflicts, together with the inconvenience and even friction which is attendant upon such relations. While this was noticeable in a few points which may possibly result in the temporary withdrawal of a few organizations, the advance made has been no less permanent than real in character.

To be sure, there are some scientific men who have not yet grasped the meaning of organization in scientific fields, and to whom the temporary inconveniences of an affiliation, the minor details of which have not yet been completed, appear to overshadow the great benefits which must result to science at large from the strength of the ultimate union. Despite this, the broader view has appealed so strongly to the members of most sections that amicable relations have been entered into between these and the national societies of technical character, and there has resulted a great improvement of the program for those in attendance upon the meetings and of effort and influence for the mutual advancement of the organizations. No one can doubt this on examination of the programs of the sections, which manifest an especially high standard in the character of the papers presented. Those in attendance upon future meetings may look with confidence to the presentation only of that which is most valuable to the worker in the field of the section. The marked improvement in the character of the contributions can only be demonstrated by the reports of the secretaries, which will appear subsequently. The more serious

character of the meeting was directly reflected in the marked respect paid to it by the press, and the period during which the influence of the association will be commensurate with the importance of the subjects it represents may be confidently said to have commenced.

Despite occasional criticisms of individuals as to the excessive growth of machinery, the association still needs perfecting in some details of organization in order to handle with expedition and without friction the enormous mass of business incident to the association of such wide scientific interests. Many details might profitably be systematized and removed from the hands of the overburdened secretaries, to be discharged in routine fashion by errand boys or clerks, and once provided for, would be carried out through successive years as a matter of course and without demand upon the time of any officer of the association, whose energy may better be devoted to the performance of the scientific duties connected with his post. Every means possible should be employed to enable officers, as well as members, to lend their energies to those objects for which the association primarily exists, and with the perfection of this machinery will cease of necessity the isolated criticisms which have been made by those of pessimistic habit with regard to the over-organization of the association. The same machinery which was adequate to provide for the needs of an organization of 1,000 members with an annual attendance of 200 will not suffice for an association of four times that size and attendance. The sooner scientific men profit from the experience and practice of successful enterprises in the world of business, the greater will be the success of the forward movement in the world of science.

One cannot overestimate the part which is being played in this new movement by the affiliated societies, many of international renown, which have come into relations with the association. Most of these are of technical character and are establishing with the sections desirable relations of an advisory and directive type. This they are well able to do by virtue of the professional character of their membership, and American science may confidently expect great results from the intimate relation in which such societies stand to many of the sections. It is to be sincerely regretted that in one or two cases the spirit of the movement has failed to reach other organizations, where some members have strongly opposed the cultivation of any relations whatever, and it may be given as more than an individual opinion that such men have failed to give thoughtful consideration to the real consequences of the armed neutrality which their position invokes. It may be said with frankness that even before such organizations some matters of the most trivial character are presented, while the section programs have to offer that which would be of broad and genuine interest to the members of the society. Both sides have much to gain, and neither has anything comparable or even considerable to lose by the proposed *entente cordiale*.

It would be improper to pass the subject of these affiliated societies without reverting in a word to one of an entirely different character which has played an important part at Washington. The American Society of Naturalists has performed an invaluable service for those in attendance in its afternoon discussion on the most effective use of endowments for scientific research, which was participated in by six members of broad view and striking individuality, and by its annual dinner, with an address by the president on the characteristics and distribution in different fields of American men of science,

which provoked generous and general discussion of the questions involved.

Important progress was made toward the establishment of a permanent policy in the association by several amendments to the constitution and practices which were put into operation. The members of the sectional committees were elected for terms varying in length from one to five years, thus insuring the continuance of at least four members familiar with committee work from one year to the next; the secretaries of the sections were elected for terms of five years, and the council elected nine fellows at large for varying terms. The continuity this secures in the governing body of the association will add greatly to its efficiency in the advancement of science. The members at large, with their terms of service, are as follows:

J. McK. Cattell, U. S. Grant, William Kent, term ending 1904.

J. M. Coulter, A. A. Noyes, H. F. Osborn, term ending 1905.

Franz Boas, E. L. Nichols, W. F. Wilcox, term ending 1906.

The following resolutions of importance to the policy of the association were discussed and adopted:

Resolved, That any section is hereby authorized to arrange through its sectional committee for an independent summer meeting in any year when the association fails to hold a summer meeting; provided, that the time and place of meeting and the general program be approved by the president and permanent secretary of the association and that a full report of its meeting be sent to the permanent secretary. The expenses of any such meeting to an amount not exceeding fifty dollars will be borne by the association.

Resolved, That Section E is hereby authorized to suspend its scientific program of the reading of papers at any winter meeting when the Geological Society of America meets in conjunction with the association; provided that the Geological Society includes in its program the papers of worthy character offered by members of the section who are not fellows of the society.

Resolved, That each section is recommended to hold during each general meeting at least one afternoon session when a program of general interest shall be presented.

It was recommended that the elections to fellowship be announced to the section from which the member elected had been recommended.

The council voted unanimously to increase the salary of the permanent secretary from $1,250 to $1,500 on account of the greatly increased membership of the association and attendance at the meetings, which have multiplied the duties devolving upon the office.

The amendment to the constitution proposed at the Pittsburgh meeting and printed in full in Science, Volume XVI., page 42, was adopted, and further amendments were presented altering the word 'assessment' to 'dues' in three places.

Resolutions, demonstrating the important part that will hereafter be taken in the association by the newly established section of physiology and experimental medicine, were passed as follows:

Resolved, That the American Association for the Advancement of Science hereby records its sense of the great loss sustained by science in the death of Major Walter Reed, surgeon in the United States Army, and its appreciation of the far-reaching and invaluable services which he has rendered to humanity. By solving the problem of the mode of spread of yellow fever, Major Reed not only made a great contribution to science, but at the same time conferred inestimable benefits upon his country and upon mankind. To have discovered and demonstrated the methods, which have already been successfully tested in Cuba, of eradicating a wide-spread and terrible pestilence, is a benefaction of imperishable renown, of incalculable value in the saving of human lives, of vast importance to commercial interests, and deserving of the highest rewards in the power of his countrymen to bestow. This association earnestly urges upon the attention of Congress the duty of making full provision for the support of his family.

Resolved, That the President designate a committee of nine members of this Association, with power to increase its number, which shall be authorized and requested to devise and carry out a

plan, or aid in similar efforts elsewhere instituted, by which a suitable and permanent memorial of this great benefactor of his race may be secured. This committee shall be authorized to prepare and publish a statement of the services of the late Major Reed in discovering the mode by which yellow fever may be exterminated.

The members appointed by President Remsen to serve as such committee are: Dr. D. C. Gilman, Dr. A. Graham Bell, General George M. Sternberg, Mayor Seth Low, Hon. Abram S. Hewitt, President J. G. Schurman, Dr. S. E. Chaillé, Dr. W. H. Welch, Dr. Charles S. Minot.

The second resolution was as follows:

Inasmuch as the construction of the isthmian canal is through a region in which without energetic sanitary control there is sure to be enormous loss of human life from preventable diseases, particularly from pernicious malaria and yellow fever, as well as great waste of energy and of money from disabilities caused by such diseases, and

Inasmuch as the measures for the restraint of these diseases, which have already achieved even their extermination in Cuba under American administration, require expert knowledge based upon practical familiarity with tropical diseases, experience in the application of these measures, and large authority in their administration,

RESOLVED, That the American Association for the Advancement of Science begs most respectfully and earnestly to call to the attention of the President of the United States the importance of appointing as a member of the Isthmian Canal Commission a medical man possessed of the qualifications indicated. The association is convinced that the mere employment of such a sanitary expert by the commission will not be likely to secure the desired results.

RESOLVED, That the permanent secretary of the association transmit a copy of these resolution to the President of the United States.

Section F recommended to the council the following resolution, which was adopted:

The American Association for the Advancement of Science heartily endorses the plan of converting the Donnelson estate, which has recently become the property of the State of Indiana, into a State Reserve, and urges upon the legislature of Indiana the advisability of setting aside a part of it for an experimental farm for the investigation of cave animals and plants by American naturalists.

The grants recommended by the council and announced to the general session were as follows:

To the committee on the atomic weight of thorium, $50.

To the committee on anthropometry, $50.

To the Concilium Bibliographicum, $100.

In addition to these it was announced that the Botanical Society of America had made the following grants in aid of research:

To Dr. J. C. Arthur, $90, to be used in the prosecution of his investigations of the plant rusts.

To Dr. Arthur Hollick, $150, to be used in the prosecution of a study of the fossil flora of the Atlantic coastal plain.

To Dr. D. S. Johnson, $200, to enable him to obtain material from tropical America and carry forward his studies of the endosperm and seed in the Piperaceae and Chloranthaceae.

The reports of the committees on the teaching of anthropology, on indexing chemical literature and on the atomic weight of thorium were duly received and will be printed subsequently. Other reports were submitted and adopted, as follows:

COMMITTEE ON ANTHROPOMETRY.

This committee begs to report that anthropometric researches have been continued at Columbia University under the direction of its New York members and with the cooperation of Professor Farrand, Professor Thorndike, Dr. Wissler, Mr. Bair, Mr. Davis and Mr. Miner. Tests have been made on the freshmen entering the college, calculations have been carried out on measurements of school children, and new determinations of the mental traits of school children have been made and correlated. The chairman of the committee has carried forward an extensive anthropometric study of American men of science, the preliminary results of which formed the subject of his address as president of the American Society of Naturalists. An anthropometric laboratory has been arranged at the present meeting of the association, with the $50 appropriated at the Pittsburgh meeting for the purpose, and tests of the physical and mental traits of members are being made. We ask that this committee be continued and that a

further appropriation of $50 be made in order that a similar laboratory may be arranged at the next meeting of the association.

J. McK. Cattell,
W J McGee,
Franz Boas.

Washington, D. C., December 30, 1902.

Council, American Association for the Advancement of Science. Gentlemen: In behalf of the committee on cave investigation, I beg leave to submit the following report of work in hand and contemplated.

The most important single item of interest is the discovery that there are two instead of one species of *Typhlichthys* south of the Ohio River. I secured the second species at Horse Cave, Kentucky, in numbers and under conditions that practically insure the securing of a complete series of individuals illustrating the life history from the egg to old age.

A colony of *Amblyopsis* has been successfully transplanted to a cave within five miles of my laboratory, where they are breeding.

A preliminary examination of the eyes of the Cuban blind fish shows that the amount of ontogenetic degeneration is very great, and that the variability of this useless organ is all and much more than the cessation of natural selection would lead one to expect.

With an assistant I have undertaken a series of measurements of the physical conditions of Mammoth Cave, chiefly of the air currents at the entrance and in different galleries of the cave, and the temperature in a series of places.

The colony of *Amblyopsis* planted in an outdoor pool has come to grief. It demonstrated beyond a doubt that the cave vertebrates can be colonized in open pools, and this should be done at once.

There is a balance of about $45 on hand out of the $75 appropriated at the last meeting.

Respectfully submitted,
C. H. Eigenmann.

COMMITTEE ON VARIATION.

The most important events relating to the study of variation that have occurred during the past two years have been the establishment of the journal *Biometrika*, the foundation in America of a Society of Plant and Animal Breeding, the completion of the first volume of De Vries' 'Mutationsteorie,' and the rediscovery of Mendel's Law of Hybridity. Especially the latter two events have awakened a strong tendency toward the experimental study of evolution.

During the last four months the recorder has visited many of the experimental evolutionists of Europe. While the total work on this subject in Europe is of the greatest importance, it is carried on under conditions that greatly hamper the work and make it impossible to start experiments that require to be carried on for a long period of years. Everywhere the hope was expressed that in America a permanent station for experimental evolution would be founded, and it was believed that the Carnegie Institution would be the proper organization to initiate and maintain such a station.

Chas. B. Davenport,
Recorder.

Owing to the fact that the meeting began before the close of the fiscal year, the financial reports from the permanent secretary and the treasurer were presented informally, and the formal reports were postponed until the April meeting of the council.

In the sessions of the council and of the association the usual order of procedure was followed. Events of more general interest in these as well as during the days of the meeting may be chronicled as follows:

The first general session of the association was held on Monday, December 29, 1902, at 10 A.M., in St. Matthews Church. It was called to order by the retiring President, Professor Asaph Hall, U.S.N., who introduced the President-elect, Dr. Ira Remsen. Cordial addresses of welcome were delivered by Dr. Charles D. Walcott, in behalf of the Washington Academy of Sciences and other scientific societies; the Hon. Henry B. F. Macfarland, on behalf of the District of Columbia; Hon. David J. Hill, on behalf of the National Government; and Dr. Charles W. Needham, President of Columbian University, on behalf of the educational institutions of Washington. To these President Remsen responded.

At one o'clock P.M. on Monday the local committee invited visiting scientific people to a luncheon at the Arlington, and on the same afternoon the address of the vice-

presidents, now in course of publication in SCIENCE, were given as follows:

At 2:30 P.M.:

Vice-President Hough before the Section of Mathematics and Astronomy on the third floor of the Columbian University, main building.

Vice-President Franklin before the Section of Physics on the second floor of the Columbian University Law School (Lecture Hall A). Subject: 'Limitations of Quantitative Physics.'

Vice-President Weber before the Section of Chemistry on the second floor of the Columbian University Medical School. Subject: 'Incomplete Observations.'

Vice-President Culin before the Section of Anthropology on the first floor of the Columbian University Law School. Subject: 'New World Contributions to Old World Culture.'

Vice-President Welch before the Section of Physiology and Experimental Medicine in the main lecture room, first floor, main building of the Columbian University.

At 4 P.M.:

Vice-President Flather before the Section of Mechanical Science and Engineering on the second floor of the Columbian University Law School (Lecture Hall B). Subject: 'Modern Tendencies in the Utilization of Power.'

Vice-President Nutting before the Section of Zoology on the second floor of the Columbian University Medical School. Subject: 'Some of the Perplexities of a Systematist.'

Vice-President Campbell before the Section of Botany on the first floor of the Columbian University Medical School. Subject: 'The Origin of Terrestrial Plants.'

Vice-President Wright before the Section of Social and Economic Science in the main lecture room, first floor, main building of Columbian University. Subject: 'The Psychology of the Labor Question.'

At this hour also was delivered the address of the president of the Astronomical and Astrophysical Society of America, Professor Simon Newcomb.

The annual address of the retiring president, Professor Asaph Hall, U.S.N., read on Monday evening, was published in the last issue of SCIENCE. At its close Past-President C. S. Minot spoke of the new movement on which the association has entered.

On Tuesday evening the address of the president of the American Chemical Society, Dr. Ira Remsen, was given and followed by the annual dinner of the society.

At the same time Dr. C. Hart Merriam delivered the public lecture of the American Society of Naturalists on 'Protective and Directive Coloration of Animals with Especial Reference to Birds and Mammals,' which was followed by the smoker of the American Society of Naturalists and its affiliated societies. At the same time the Botanical Society of Washington received visiting botanists. The Sigma Xi Scientific Society also met the same evening.

On Wednesday afternoon at 3 o'clock the annual discussion of the American Society of Naturalists was held. The subject was 'How can Endowments be used most Effectively for Scientific Research?' and the speakers were Professors T. C. Chamberlin, William H. Welch, Franz Boas, William M. Wheeler, Conway Macmillan and Hugo Münsterberg.

On Wednesday afternoon at 4 o'clock a public lecture was given under the auspices of the A. A. A. S. and the National Geographic Society on 'Volcanoes of the West Indies,' by Professor I. C. Russell.

Mrs. Chas. D. Walcott gave a tea on Wednesday afternoon at 5 o'clock to visiting ladies of the association, and to the members of the Geological Society of America.

On Wednesday evening the annual dinner of the American Society of Naturalists was held, and the dinner was followed by the address of the president, Professor J. McK. Cattell.

The annual dinner of the Geological Society of America and a smoker tendered by the Chemical Society of Washington were also held.

On Thursday evening, through the courtesy of the board of regents and the secretary of the Smithsonian Institution, the U. S. National Museum was open from

8:30 to 11 P.M., to afford a convenient opportunity for viewing the collections.

On Friday afternoon at 4 o'clock an illustrated public lecture complimentary to the citizens of Washington was given at the Lafayette Opera House, by Professor John Hays Hammond, on 'King Solomon's Mines, or the Mines of Ophir.'

On Friday evening the trustees of the Corcoran Art Gallery and the local committee tendered a reception to the visiting members of the association and the affiliated societies at the Corcoran Art Gallery, from 8:30 to 11 o'clock. On Friday evening also was held the dinner of the American Alpine Club.

On Saturday morning at 10 o'clock the President of the United States received the members of the A. A. A. S. and affiliated societies at the White House.

Resolutions of thanks for courtesies extended were offered by Ex-President Minot and unanimously adopted at the closing general session. The institutions and individuals to whom the association was especially indebted include: Columbian University, Cosmos Club, Local Committee and its secretary (Dr. Benjamin), St. Matthew's Church, Georgetown University, Caroll Institute, Press of Washington, Trustees of Corcoran Art Gallery, the President of the United States, secretary of the Smithsonian Institution, acting director of the U. S. National Museum, director of the Naval Observatory, U. S. commissioner of Fish and Fisheries.

At the meeting of the general committee on Thursday evening it was decided to hold the next meeting of the association in St. Louis during convocation week, 1903–4, and to recommend Philadelphia as the place of the following meeting. The following were elected officers for the St. Louis meeting:

President—Carroll D. Wright, Washington.

Vice-Presidents—Section A, Mathematics and Astronomy, O. H. Tittmann, Washington; B, Physics, E. H. Hall, Harvard University; C, Chemistry, W. D. Bancroft, Cornell University; D, Mechanical Science and Engineering, C. M. Woodward, Washington University; E, Geology and Geography, I. C. Russell, University of Michigan; F, Zoology, E. L. Mark, Harvard University; G, Botany, T. H. Macbride, University of Iowa; H, Anthropology, M. H. Saville, American Museum of Natural History; I, Social and Economic Science, S. E. Baldwin, New Haven; K, Physiology and Experimental Medicine, H. P. Bowditch, Harvard University.

Permanent Secretary—L. O. Howard, Cosmos Club, Washington.

General Secretary—Chas. W. Stiles.

Secretary of the Council—Chas. S. Howe, Case School.

Secretaries of the Sections.—Section A, Mathematics and Astronomy, L. G. Weld, University of Iowa; B, Physics, D. C. Miller, Case School; C, Chemistry, A. H. Gill, Massachusetts Institute of Technology; D, Mechanical Science and Engineering (none proposed); E, Geology, G. B. Shattuck, Baltimore; F, Zoology, C. Judson Herrick, Denison University; G, Botany, F. E. Lloyd, Teachers College, Columbia University; H, Anthropology, R. B. Dixon, Harvard University; I, Social and Economic Science, J. F. Crowell, Washington; K, Physiology and Experimental Medicine, F. S. Lee, Columbia University.

Treasurer.—R. S. Woodward, Columbia University, New York, N. Y.

Henry B. Ward,
General Secretary.
The University of Nebraska.

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*MODERN TENDENCIES IN THE UTILIZATION OF POWER.**

It has been stated that to the construction and perfection of her machinery, more than to any other cause, may be ascribed the present commercial supremacy of the United States.

Be that as it may, the economical production of her manufactures and the convenient adaptations of time and labor

* Address of the chairman of Section D, Engineering and Mechanical Science, and vice-president of the American Association for the Advancement of Science. Read at the Washington meeting, December 29, 1902.

saving devices in all the various lines of constructional work have certainly exerted a wonderful influence in the upbuilding of her industries.

Specialization in the manufacture of machine tools and labor-saving devices has followed closely the segregation of processes in other lines of industry, and thus there has been created a multitude of special machines, each designed to perform some single and often very simple operation.

Among other significant features the present tendency in the development and use of this class of machinery is marked by the adaptation of compressed air and the application of electric power to machine driving. In the use of compressed air, the facility of adaptation to various requirements which are in many cases additional to the supply of motive power, is a valuable feature peculiar to this system and one which is susceptible of extension along many lines.

The labor cost in most machine shops and other works is so much greater than the cost of power, that any expedient by which the labor cost may be appreciably reduced is justified, even though the efficiency of the agent itself be low. Whenever new methods or agencies cause an increased production with a given outlay for labor, we shall find these methods superseding the old, even though the cost of the power required be greater than before. The saving of power is a consideration secondary to the advantages and economical output obtained by its use.

While economy in the use of power should therefore be secondary to increased output, yet careful attention to details will often greatly reduce the useless waste of power.

Engineers have recognized for some time past that there is a very great percentage of loss due to shaft friction, which, in railroad and other shops where the buildings are more or less scattered, may be as great as 75 per cent. of the total power used. In two cases known to the speaker these losses are 80 and 93 per cent., respectively. In the ordinary machine shop this loss will probably average from 40 to 50 per cent. No matter how well a long line of shafting may have been erected, it soon loses its alignment and the power necessary to rotate it is increased.

In machine shops with a line of main shafting running down the center of a room, connected by short belts with innumerable counter-shafts on either side, often by more than one belt and, as frequently happens, also connected to one or more auxiliary shafts which drive other countershafts, we can see why the power required to drive this shafting should be so large. There is no doubt, however, that a large percentage of the power now spent in overcoming the friction of shafting in ordinary practice could be made available for useful work if much of the present cumbrous lines of shafting were removed.

Manufacturers are realizing the loss of power which ensues from the present system of transmission, and we find a general tendency to introduce different methods by which a part of this loss will be obviated. Among these are the introduction of hollow and lighter shafting, higher speeds and lighter pulleys, roller bearings in shaft hangers, and the total or partial elimination of the shafting.

Independent motors are often employed to drive sections of shafting and isolated machines, and among these we find steam- and gas-engines, electric motors, compressed air and hydraulic motors, although the latter have not been used for this purpose to any appreciable extent.

In the choice of motors, until quite recently the steam-engine has heretofore been

used, especially where the units are relatively large. An interesting example of this is noted in the sugar refinery of Claus Spreckles, in Philadelphia, in which there are some 90 Westinghouse engines about the works, many of them being of 75 and 100 horse-power each, others are of 5 and 10 horse-power only. A similar subdivided power plant involving 42 engines was erected several years ago at the print works of the Dunnell Co., Pawtucket, R. I.

It was only a comparatively few years ago when several large and economical Corliss engines were replaced at the Baldwin Locomotive Works by a greater number of small, simple expansion engines, which actually required about 15 per cent. more steam per horse-power-hour than the Corliss engines. This loss, however, was only apparent, for by increasing the number of units and locating them at convenient centers of distribution much of the shafting and belting could be dispensed with and an actual saving was obtained. Later, these simple engines were replaced by a number of compounds, some eighteen being in service; subsequent tests on these showed a saving of 36 per cent. over that obtained by the use of the simple engines.

More recently, however, the electric motor has superseded the steam-engine for this work, as its economy and convenience over the latter are now thoroughly recognized.

The statistics of American manufacturing compiled by Mr. T. C. Martin for the United States Census Office, show that at the time of the last census, in 1900, electric power was less than five per cent. of all that was in use in such plants, or about 500,000 horse-power out of a total of 11,000,000; but, as Mr. Martin states, things are to be judged by tendencies rather than by the *status quo*, and these electric motor figures exhibit an increase of 1,900 per cent. during the decade.

The introduction of the electric motor in machine shops and factories was at first looked upon with disfavor and was opposed by many manufacturers, but the innovation obtained a foothold, and advantages which were at first unforeseen were found to attend its use, so that now it is being very generally adopted for a wide variety of work.

A considerable difference of opinion exists as to whether individual motors should be used with each machine, or whether a number of machines should be arranged in a group and driven from a short line shaft.

There are well-defined conditions to which each system is best adapted, but there are wide limits between which there appears to be no general rule, and we find both methods occupying the same field.

For isolated machines and for heavy machines that may be in occasional use the individual motor is particularly well adapted, as it consumes power only when in operation. It is, however, necessary that each motor thus connected shall be capable of supplying sufficient power to operate its machine under the heaviest as well as lightest loads. In certain cases, moreover, the load is liable to very great irregularity, as for instance in metal-working planers, in which the resistance offered by the machine at the moment of reversal of the platen is far higher than at other times, and may be so great as to endanger the armature of the motor. Under these conditions it is necessary to use a motor of much larger capacity than the average load would indicate.

Fortunately with electric motors the rated capacity is usually less than the safe maximum load, which is determined either by the heating of the conductors, tending to break down the insulation, or by ex-

cessive sparking at the brushes. For momentary overloads relatively large currents may pass through the coils without injury to the insulation, since the temperature effect is cumulative and requires time for its operation. However for continuous periods of considerable length it is usually unsafe to operate the motor much above its rated output.

Ordinarily in machine-driving the motor is shunt-wound, and the current through the field-coils is constant under all conditions of load; but to obtain the best results with that class of machinery in which the load is intermittent and subject to sudden variations, the motor should be compound-wound so as to increase the torque without an excessive increase of current in the armature.

In many cases with individual motors, owing to wide variations in power required, the average efficiency of the motor may be very low; for this reason a careful consideration of the conditions governing each case indicates that for ordinary machine-driving, especially with small machines, short lengths of light shafting may be frequently employed to good advantage, and the various machines, arranged in groups, may be driven from one motor. By this method fewer motors are required, and each may be so proportioned to the average load that it may run most of the time at its maximum efficiency.

When short lengths of shafting are employed the alignment of any section is very little affected by local settling of beams or columns, and since a relatively small amount of power is transmitted by each section, the shaft may be reduced in size, thus decreasing the friction loss. Moreover, with this arrangement, as also with the independent motor, the machinery may often be placed to better advantage in order to suit a given process of manufacture; shafts may be placed at any angle without the usual complicated and often unsatisfactory devices, and a setting-up room may be provided in any suitable location as required, without carrying long lines of shafting through space. This is an important consideration, for not only is the running expense reduced thereby, but the clear head-room thus obtained, free from shafting, belts, ropes, pulleys and other transmitting devices, can be more easily utilized for hoists and cranes, which have so largely come to be recognized as essential to economical manufacture.

In arranging such a system of power distribution the average power required to drive is of as much importance as the maximum, for in a properly arranged group system the motor capacity need not be the equivalent of the total maximum power required to operate the several machines in the group, but may be taken at some value less than the total, depending upon the number of the machines and the average period of operation. On the other hand as already shown, the motor capacity of independently driven machines must not only equal the maximum power required to drive the machine at full load, but it must be capable of exerting a greatly increased momentary torque. In any case large units should be avoided, for the multiplication of machines driven from one motor entails additional shafting, countershafts and belting which may readily cause the transmission losses to be greater than those obtained with engines and shafting alone, besides frustrating some of the principal objects of this method of transmission.

As far as the efficiency of transmission is concerned, it is doubtful whether, in a large number of cases, motor-driving *per se* is any more efficient than well-arranged engines and shafting.

As already pointed out, the principal

thing to be kept in mind is a desired increase in efficiency of the shop plant in turning out product, with a reduction in the time and labor items, without especial reference to the fuel items involved in the power production.

On account of the subdivision of power which results from the use of many motors, there is less liability of interruption to manufacture, and in case of overtime it is not necessary to operate the whole works, with its usual heavy load of transmitting machinery.

Another advantage is the adaptability to changes and extensions; new motors may always be added without affecting any already in operation, and the ease with which this system lends itself to varying the speed of different unit groups is a very potent factor in its favor.

One serious obstacle to the use of connected motors with machine tools is the difficulty of obtaining speed variation, which is so necessary with a large proportion of the machines in common use. A certain amount of variation can be obtained by rheostatic control—a wasteful method; or by using a single voltage system with shunt field regulation; but the variation in either case is very limited. This, however, may be increased by using a double commutator if space will permit.

The three-wire, 220-volt system offers many advantages for both power and lighting systems, and is very frequently employed. Variations of speed may be obtained with this system by using a combination of field regulation with either voltage, and, in rarer cases, the use of a double commutator motor.

A method which has been used recently with considerable satisfaction involves the use of a three-wire generator, with collector rings connected to armature winding similar to that of a two-phase rotary converter. Balancing coils are used, and the middle points of these are connected to the third wire, which is thus maintained at a voltage half-way between the outer wires. This system is simple and economical, and possesses all the advantages of the ordinary three-wire method; it permits similar variations in speed by field regulation with either voltage; and if still wider ranges are desired a double commutator motor may also be used.

In other recent installations the four-wire multiple voltage system is used, which permits of very wide variations of speed in the operation of the tool. This system gives excellent results and removes one of the objections urged against direct-connected motor-driven tools, namely, that such machines are not sufficiently flexible in regard to speed variation, and that such variation can only be obtained by throwing in resistances which cut down the efficiency of the motor, or by varying the strength of field which reduces the torque.

The multiple voltage system, however, has some serious disadvantages. It can not usually be operated from an outside source of power without rotary transformers; the generating sets and switch-board are complicated and the total cost of installation is expensive; yet with these drawbacks the system is growing in favor, as it has manifest advantages which outweigh the objections.

The storage battery has been used to some extent to obtain multiple control and is suggestive of interesting possibilities, but in its present form it is not altogether desirable for machine tools.

In many of the larger sizes of certain metal-cutting machines it is probable that marked changes will be produced in the immediate future, and the indications are that direct-connected motors with wide variations of speed and power will be incorporated in the new designs.

The recent improvements in the manufacture of certain grades of tool steel have shown indisputably that the present designs of machine tools are not sufficiently heavy to stand up to the work in order to obtain the economy of operation which results from the use of such steels. Higher speeds, heavier cuts and greater feeds may be obtained if the machines will stand the strain, but in most cases the capacity of the machine is not commensurate with the ability of the tool to remove metal. With cutting speeds of 100 to 200 feet per minute, it is evident that the power requirements will be much greater than for the ordinary machines of to-day, which have a cutting speed of from 10 to 30 feet per minute. As an illustration of what can be done with these new tool steels the speaker was recently shown some steel locomotive driving-wheels which had been turned up in two hours and forty minutes, whereas the regular time formerly required was not less than eight hours. In this case even better results could have been obtained, but the belts would not carry the load.

Here then we find an interesting field for the direct-connected motor with ample power and speed variation for any work which it may be called upon to perform.

While the preference is easily given to continuous-current motors for the purposes of machine driving, yet we find alternating current motors used to a considerable extent, the proportion of motors in service being about one to five in favor of the continuous-current motor. Both synchronous and induction motors are employed, but the advantages possessed by the latter cause this type to be preferred, although in long-distance transmissions, both types should be used in order to obtain satisfactory regulation. As shown by Mr. H. S. Meyer,* the induction motor can readily be worked at variable speeds, which is accomplished in three different ways: (1) by rheostatic control, which is decidedly the cheapest and easiest method to manipulate; (2) by varying the impressed voltage, which, however, necessitates the use of a transformer or compensator with variable ratio; this is very inefficient at the lower speeds and can only be used under certain conditions; and (3) by altering the number of poles, which is mechanically very complicated, but where the speed variation is only one half or one quarter it may be used efficiently.

* *London Engineering*, April 19, 1901.

One serious disadvantage met with in all induction motors is the lag produced by self-induction, and its reaction on the circuit. This lag is particularly unsatisfactory with intermittent service, such as machine driving, where the motors have to run under light and variable loads; in such cases the power factor is probably not over 60 or 70 per cent.

Reference has been made to the use of compressed air and its facility of adaptation to various requirements, but it is evident from an inspection of some of the devices in use that enthusiasm for new methods, rather than good judgment, has controlled in many of its applications.

For some years compressed air was used only in mines, where it produced marked economies in underground work. Later, compressed air was introduced into manufacturing lines, and to-day its use in railroad and other machine shops, boiler shops, foundries and bridge works is being widely extended. In the Santa Fe Railroad shops at Topeka there are over five miles of pipe in which compressed air is carried to the different machines and labor-saving appliances throughout the works.

In such shops air is used to operate riveting machines, punches, stay-bolt breakers, stay-bolt cutters, rotary tapping and drilling machines, flue rollers, rotary grinders,

rotary saw for sawing car roofs, pneumatic hammers, chisels and caulking tools, flue welders, boring and valve-facing machines, rail saws, machine for revolving driving-wheels for setting valves, pneumatic painting and whitewashing machines, dusters for car seats and the operation of switching engines about the yard. It is also used in the foundry for pressing and ramming molds, and for cleaning castings by the sand blast; but its greatest field of usefulness is its application to hoisting and lifting operations in and about the works.

New applications of compressed air are constantly being made, and each new use suggests another. This has a tendency to increase the number of appliances which are intended to be labor-saving devices, but in many cases the work could be done just as well and much more cheaply by hand.

A case in point is seen in an apparatus which was at one time in use on one of our prominent western roads. It was a sort of portable crane hoist which could be fastened to the smoke-stack of a locomotive, whereby one man could lift off the steam chest casing. The hoisting apparatus weighed about twice as much as the steam chest and took three men to put it up. When piece work was adopted two men easily lifted off the steam chest and this 'time and labor saving device' was relegated to the scrap heap.

While compressed air has been used to some extent for inducing draft in forge fires, it is unquestionably a very expensive method. Tests to determine this show that it costs twenty-five times as much to produce blast in that way as it would with a fan.*

The success and economy which has attended the use of compressed air in so many lines of work has led to its adoption in fields which are much better covered by electrically operated machines. While compressed air has been used under certain conditions very satisfactorily to operate pumps and engines, printing-presses, individual motors for lathes, planers, slotters, dynamos and other work, it does not follow that it is always an economical agent under these various uses, or that other methods could not be used even more satisfactorily in the majority of cases.

It has been proposed to use individual air motors in machine shops and do away with all line shafting, except possibly for some of the heavier machinery. This use of compressed air seems entirely outside the pale of its legitimate field; the general experience thus far indicates that rotary motors are not at all economical and generally are not as satisfactory as electric motors.

Exceptions are to be found in the small portable motors for drilling and similar operations, to which electricity is not at all adapted and where compressed air has been found to give excellent results. The saving obtained by the use of such portable drills as compared with a ratchet drill is very marked.

Although these tools are very successful they are still rotary motors, not exempt from some of the objectionable features which seem to be inseparable from them. It is not surprising, therefore, to find a tendency to employ reciprocating pistons and cranks in these portable machines and we note such tools weighing only forty pounds capable of drilling up to two and a half inches diameter.

While the field is to some extent limited, yet the uses of compressed air are certainly not few, and in many lines of work marked economy results from its use.

In most cases no attempt has been made to use the air efficiently; its great convenience and the economy produced by its displacement of hand labor have, until re-

* *Proc. Western Ry. Club,* 1898.

cently, been accepted as sufficient, and greater economies have not been sought.

In the matter of compression we still occasionally find very inefficient pumps in use, but manufacturers generally have found that it pays to use high-grade economical compressors. The greatest loss is that in the air motor itself. In a large number of cases it is impracticable or, at most, inconvenient to employ reheaters, and we find very generally that the air is used at normal temperature for the various purposes to which it is applied.

To obtain the most satisfactory results the air must be used expansively, but usually where the demand for power is intermittent no attempt has been made to reheat the air, and as a result the combined efficiency of compressor and motor is quite low, varying in general from 20 to 50 per cent. While low working pressures are more efficient than high, the use of such pressures would demand larger and heavier motors and other apparatus which is undesirable.

The advantages of higher pressures in reducing cost of transmission are also well recognized, and the present tendency is to use air at 100 to 150 pounds instead of the 60 or 70 pounds of a few years ago.

By reheating the air to a temperature of about 300° F., which may often be accomplished at small expense, the efficiency is greatly increased; in some cases this has been shown to be as high as 80 per cent. While the lower pressures are yet more efficient, the loss due to higher compression is not serious.

If air be used without expansion it will be seen that there is a material loss in efficiency; but, on the other hand, if it be used expansively without reheating, trouble may be experienced, due to the drop in temperature below the freezing point. If moisture be present this will cause the formation of ice, which may clog the passages if proper precautions are not taken to prevent it. The low temperature will not in itself cause trouble; if, therefore, the moisture which the compressed air holds in suspension be allowed to settle in a receiving tank, placed near the motor or other air apparatus and frequently drained, less trouble will be experienced from this cause.

While it may be impracticable to reheat the air in certain cases, yet there are many situations where a study of means to overcome the losses referred to would result in marked economies.

The greater adaptability of compressed air to various purposes causes its use to increase along with that of the electric motor, for it has a different field of usefulness, independent of power transmission; at the same time when the requirements are properly observed in its production and use, its economy as a motive power in special cases compares favorably with other systems. With a better knowledge of the principles involved we may expect much better results than have yet been attained.

But compressed air possesses so many advantages that, however inefficient it may be as a motive power, its application to shop processes will be continually extended as its usefulness becomes better known.

Mention has been made of the use of hydraulic motors as a factor in the subdivision of power, but these are being used to such a limited extent for this purpose that we shall not consider them at the present time.

There is, however, a growing field of usefulness for hydraulic power in manufacturing operations which is peculiar to this agent alone, namely, its use in forging and similar work. Where hydraulic power exists for this purpose it is also generally used for a variety of purposes which could be accomplished just as well, and often more

economically, by steam or compressed air; but in forging operations where heavy pressures are required hydraulic power is infinitely better than either.

The compressibility of air is an objection in many lines of work, and it is now well recognized that the effect of a hammer blow is oftentimes merely local. As Mr. H. F. J. Porter has so ably shown elsewhere,* the pressure applied in forging a body of iron or steel should be sufficient in amount and of such a character as to penetrate to the center and cause flowing throughout the mass; as this flowing of the metal requires a certain amount of time the pressure should be maintained for a corresponding period.

Hydraulic pressure, instead of a hammer, should, therefore, be used to work it into shape. Under its action the forging is slowly acted upon and the pressure is distributed evenly throughout the mass, whereas under the high velocity of impact of the hammer the metal does not have time to flow, and thus internal strains are set up in the mass, which may cause serious results, especially with certain steels which have not the property of welding.

Besides the fundamental defects incident to the method, it is very troublesome to use a hammer in certain lines of work, on account of mechanical difficulties of manipulation.

The quality of the steel is very much improved by the processes of hydraulic forging, and we find a marked tendency to substitute this method in a wide variety of work in which presses are employed varying in capacity from 20 tons to 14,000 tons.

We are all familiar with the fact that the magnificent 125-ton hammer made by the Bethlehem Steel Co. lies idle, while the work for which it was intended is done by a 14,000-ton hydraulic press operated by an engine of 15,000 horse-power; it may not be so generally known, however, that all forgings except small pieces are done on hydraulic presses, and that the largest hammer in actual operation is one of 6 tons capacity in the blacksmith shop.

The pressure used in these works is 7,000 pounds per square inch, but the present tendency indicates the use of a so-called low-pressure transmission service under a pressure of 400 or 500 pounds, with an intensifier at the press which raises the pressure to 2,500, 5,000, 7,000 pounds, or whatever may be required.

In this case the lifting and lowering of the ram of the press is effected by low-pressure water, so that the cylinder always remains filled, and the high pressure is only brought to bear the moment the dies come in contact with the pieces to be forged. The intensifier is built in multiple, which permits of a variable force to suit the work to be done; its action and control are extremely simple, and results are produced which show a marked increase in speed and a decided economy in operation. Some of the recent German hydraulic forging machines equipped with intensifier operate at a speed of forty to seventy strokes per minute, on finishing, and twenty to thirty strokes per minute for the heaviest work.

The success which has attended the use of hydraulic power in forging is causing it to be applied to other and similar work to an increasing extent. In boiler works, railroad and locomotive shops, bridge works and ship-yards it is used along with compressed air, but where heavy pressures are desired hydraulic power is greatly to be preferred; hence we find it operating machines for punching and shearing heavy plates and sectional beams, riveting machines, stationary and portable, flanging and bending machines, tube upsetting ma-

* *Trans. A. S. M. E.*, Vol. XVII.

chines, wheel and crank-pin presses, lifting jacks and hoists of all kinds.

For heavy boiler work hydraulic riveting seems especially well adapted, as an intensity of pressure can be brought to bear upon the plates which is obtained by no other method.

We have already stated that compressed air as now used without reheating is not at all efficient as a source of motive power, since the combined efficiency of compressor and motor, even under favorable conditions, is not more than 50 per cent. of the available energy put into the compressor. In other cases the efficiency is as low as 20 per cent.

In the transmission of air, within reasonable limits, the loss in transmission if the pipes be tight need not be considered, for although there is a slight loss in pressure due to the frictional resistances of the pipes, yet there is a corresponding increase in volume due to drop in pressure, so that the loss is practically inappreciable.

There should be no comparison between the cost of power by compressed air and its brilliant rival, electricity, since each has its own field of usefulness, yet it may be interesting to note for our present purposes the efficiency of electric power. A modern shop generator belted from an engine will have an efficiency of about 90 per cent. when working under favorable conditions, but as the average load is ordinarily not more than two thirds full load, and often much less, the efficiency will not usually be more than 85 per cent. Since the engine friction was added to the losses in compression, so also it should be considered here, in which case the efficiency of generation will lie between 75 and 80 per cent. With a three-wire 220-volt system, which is very suitable for ordinary shop transmission when both light and power are to be taken off the same dynamo, the loss in transmission need not be more than 5 per cent., so that the efficiency at the motor terminals will not be far from 75 per cent. With motors running under a nearly constant full load the efficiency of motor may be 90 per cent.; but with fluctuating loads this may fall to 60 per cent. at quarter load. In numerous tests made by the speaker the average load on several motors in machine shops has been only about one third of the rated capacity of the motor. It is interesting to note that in tests made at the Baldwin Locomotive Works it was found that with a total motor capacity aggregating 200 horse-power, a generator of only 75 kilowatts was sufficient to furnish the current, and ordinarily only 60 kilowatts, or 40 per cent., was required. At the present time there are in use at these works upwards of 300 motors, with a combined total capacity of 2,200 or 2,300 horse-power; whereas the generator output is only about 500 kilowatts.

Under those conditions, where the driven machines are not greatly over-motored, we may assume a motor efficiency of 80 per cent., which may be less or greater in individual cases. The combined efficiency, then, of generator and motor working intermittently with fluctuating loads will be about 60 per cent. of the power delivered to the engine.

For greater distances than those which obtain in plants of this character the loss in transmission will be greater, and higher voltage must be employed in order to keep down the line loss. While it is possible to put in conductors sufficiently large to carry the current with any assumed loss, yet the cost of the line becomes prohibitive with low voltage.

Where cheap fuel is available it is found in most cases that electric power can be generated at the works more cheaply than it can be purchased from a central station;

especially is this the case if the exhaust steam be used for heating purposes. In isolated plants the cost of transmission is very small as compared with the total cost of generation; whereas in the average central station the cost of transmission, which includes interest and depreciation on pole line, usually constitutes a large percentage of the operating cost.

In those localities where the cost of fuel is high, electric power can often be purchased more cheaply from a central station which obtains its power many miles distant and transmits it electrically to a convenient distributing center, where it is used for power and light.

The recent development in electrical transmission is very marked, and one constantly hears of some new achievement more wonderful than anything previously accomplished. Distances have been gradually increased until it is now possible to transmit electrical energy economically and in commercial quantities up to 150 and even 200 miles.

There has been a steadily increasing tendency to raise the line voltage in such transmissions, and to-day we find in successful operation voltages as high as 40,000 and even 60,000 as compared with the 4,000 and 6,000 volts of a few years ago.

As pointed out by Mr. A. D. Adams,* so far as present practice is concerned the limit of use of high voltages must be sought beyond the transformers and outside of generating and receiving stations. As now constructed, the line is that part of the system where a final limit to the use of higher voltages will first be reached.

In order to avoid the temporary arcing and leakage between the several wires it is necessary to place the wires a considerable distance apart, which, with higher voltages, may lead to a modification in construction of pole line. The plan of substituting a series of steel towers about 90 feet in height and 1,000 feet apart is being seriously contemplated.*

* *Eng. Mag.*, October, 1902.

In this case it is proposed to suspend the wires from tower to tower and separate them about nine feet apart. While expensive in first cost, it is thought that the satisfactory working of the system and freedom from breakdown, with the low maintenance and depreciation charges involved, would warrant the investment.

A more serious difficulty is found in the insulator, which is generally looked upon with distrust for the higher voltages in use to-day. With a more perfect insulator there would appear to be no good reason why the present maximum voltages should not be exceeded.

The possibility of electrical transmission thus permits of the utilization of available sources of power at great distances from the center of distribution; but while it is interesting to know that a certain amount of power may be transmitted a given distance with a high degree of efficiency, it is more important to know whether the same amount of power could be obtained at the objective point more economically by other means.

It has been suggested that the future of long-distance transmission depends largely upon the development of oil as a fuel; but at the present time the outlook for oil fuel in general competition with coal or long-distance transmission is not encouraging; while the development of the Texas and southern California oil fields has increased the visible supply and brought about increased activity in the use of liquid fuel, yet it is doubtful whether the advantages would be sufficient to cause it to come into general use as a fuel, since with a limited production and an increased demand for

* Geo. H. Lukes in *Trans. Assn. Edison Illuminating Companies*, July, 1902.

this and other purposes the cost would be correspondingly increased.

A number of railroads contiguous to the oil-producing centers have equipped their locomotives to burn this fuel, and it is used to some extent to fire marine boilers, and with great satisfaction; since its displacement for a given heating value is only about one half that of coal, and the labor cost is materially reduced.

It is also used quite extensively in certain sections of the country as a steam producer in power plants, but it is hardly probable that liquid fuel will be a serious competitor of coal, notwithstanding its many advantages. At the present time, as far as power for manufacturing plants is concerned, it is largely a question of transportation, whether oil can be laid down and handled at a given point more cheaply than coal. It is probable, however, that oil fuel will supply a local demand in certain sections where transportation charges, and possibly insurance, will permit its use at a low cost, and it is in this connection that it may become a competitor of electrical transmission.

One interesting phase of the power problem which forcibly presents itself to the engineer at the present time is the vast possibilities possessed by the modern combustion engine, which includes the various types of gas- and oil-engines. While its use as a motor in industrial establishments has been somewhat limited, yet there is a marked tendency to employ the gas-engine in manufacturing works, and a consideration of its advantages and cost of operation, together with its high thermal efficiency and possibility of still further improvement, indicates that, for a great many purposes, both steam-engines and electric motors may be ultimately replaced by gas-engines.

While the first cost of electric motors in the smaller sizes is considerably less than the cost of well-made gas-engines for similar capacities, the saving during the first six months of service, due to the more economical operation of the gas-engine, will often more than compensate for the difference in first cost.

That the gas-engine in both large and small sizes has reached a point in its development where it can fairly rival the steam-engine in reliability and satisfactory running qualities there can be no question. In point of fuel economy, a gas-engine of moderate size is on a parity with the largest triple-expansion steam-engines, and will give a horse-power on less than one pound of fuel.

The high price of gas in this country has contributed largely to those causes which have prevented a more common use of the gas-engine as a motor. For this reason the gas-engine has generally been used, not so much because of its high efficiency as a thermodynamic machine, but rather on account of its convenience and saving in labor. It is true that natural gas is cheap, but it is equally true that natural gas is not generally available.

It is to producer gas that we must look for any marked increase in the use of the gas-engine. Fortunately the manufacture of producer gas has reached a high state of development, and there are now in successful use several processes by which power gas can be made from cheap bituminous coals as well as anthracite and coke. The leanness of such gases renders them less effective per cubic foot of gas, as compared with the richer coal gas or even water gas; but this difference is more than compensated for by the low cost of production. It is upon such power gas that the commercial future of the gas-engine as a general motor depends.

A prominent factor in gas-engine practice which has attained a high degree of development in European practice is the

small gas producer. These generators are very simple in operation and furnish a convenient and economical means of obtaining power at a much lower rate than with the ordinary city lighting gas. Generally small anthracite coal or coke is used, but several methods employ bituminous coal, lignites or wood. With bituminous coal, means must be provided for removing the tar and ammonia and other products of distillation.

The process of generation in some of the more recent producers is entirely automatic and depends upon the demand of the engine, so that no storage capacity is required. The economy of these small producers is shown by tests which give one horse-power on a 16-horse-power engine with a consumption of only 1.1 pound of fuel. For engines above forty horse-power one horse-power can be obtained on seven eighths pound of fuel.

The gas-engine industry received a signal impetus when it was discovered that blast furnace gases could be readily utilized direct in combustion engines without the intervention of boilers and without any special purifying processes. A still more important circumstance which is far reaching in its results is the fact shown by Professor Hubert, of the Liége School of Mines, that the superior economy of the gas-engine enables equal power to be obtained with 20 per cent. less consumption of furnace gas than was formerly used in the generation of steam.

The successful employment of large combustion engines in this way utilizes vast sources of power which a few years ago were allowed to go to waste or at most were used very inefficiently.

The high thermal efficiency of the gas-engine has long been recognized and the possibility of further development is a promising factor in this field. The already accomplished efficiency of 38 per cent. reported by Professor Meyer, of Göttingen, greatly exceeds the maximum theoretical efficiency of the steam-engine and more than doubles its actual best obtainable working efficiency, but the end is not yet.

With higher compression even greater efficiencies may be expected. But with high compression there is danger of premature explosion, due to the generation of heat in compressing the gas in the presence of oxygen; for this reason Herr Diesel compresses the air separately. Under a pressure of 500 pounds or more, which is used in the Diesel motors, the air becomes very hot and readily ignites a charge of liquid fuel which is injected into the compression chamber. There is no explosion; combustion occurs while expansion goes on and the heat generated disappears in the form of work.

Efficiencies of 30 per cent. or more have been obtained with blast furnace gases which contain a very small percentage of hydrogen, and this with the high rates of compression which can be carried has led to the advocacy of non-hydrogenous mixtures in large engines. Certainly very high rates of compression may be had with a non-hydrogenous producer gas without fear of premature ignition, and it has the additional advantage of economical production.

The practice of making the cylinder in combustion engines act alternately, first as air compressor then as motor, has the advantage of greater simplicity, but it means immensely larger engines for the same power, since the number of effective impulses is thus cut in two.

The danger of pre-ignition and consequent severe shock on the engine also necessitates very heavy construction in the smaller engines in order to obtain a reasonable degree of safety in operation.

Moreover, the smoothness of action is greatly retarded with this form of engine, especially if the governing is controlled by the 'hit-and-miss' method, in which the regulation is effected by varying the frequency of the explosions, thus causing great variations in the driving torque.

Various expedients have been employed to overcome these defects, such as the use of multi-cylinders and different methods of control, but the size and cost of engine have been increased rather than decreased. Notwithstanding these well-recognized defects in the four-cycle type of engine, it constitutes by far the largest class in use to-day of what may be called successful gas-engines.

More recently very satisfactory results have been obtained in the construction of two-cycle engines. In some of these we find separate pumps employed to compress the charge of gas and air, which ignites and burns as it enters the cylinder. Higher compression is thus obtained without fear of pre-ignition, and this permits smaller clearance spaces with attendant advantages.

If the engine is single-acting, an impulse is obtained every revolution, which thus insures better speed regulation, as well as double the power for a given sized cylinder.

The highest thermal efficiency yet attained, namely 38 per cent., has been secured with a two-cycle type of engine which compresses the air and gas in separate pumps to a nominal pressure of eight or ten pounds; the air under this pressure being used to scavenge the cylinder toward the end of expansion. After the unconsumed products of combustion have been forced out by the fresh air, the cylinder walls having been cooled thereby, a charge of gas is admitted and compressed to a pressure of 150 to 175 pounds per square inch and then exploded, as in the usual method. This engine is double-acting and receives a charge each side of the piston; thus two impulses are received each revolution, in a manner precisely similar to that of a steam-engine.

Whether these engines will be as satisfactory for small motors remains to be seen. It is possible that the greater complication of details in the two-cycle types, as compared with the simpler four-cycle engine, will cause the latter to continue to give the greater satisfaction, at least for the smaller sizes.

At the last meeting of the British Association, Mr. H. A. Humphrey gave some interesting data concerning recent gas-engines, and the record is both remarkable and significant. The limiting size has rapidly grown during the past two years, as shown by the fact that one manufacturer is now constructing a gas-engine of 2,500 horse-power and is prepared to build up to 5,000 horse-power.

The development of the large gas-engine is closely connected with the evolution of the fuel gas processes, and it is noteworthy that the first gas-engines in England above 400 horse-power were operated with producer gas, while many of the large gas-engines in Europe have been built for use with blast furnace gas.

In August of this year (1902) two leading English manufacturers had delivered or had under construction over fifty gas-engines varying in size between 200 and 1,000 horse-power; but we have to look across the Channel for still greater achievements in this direction.

Neglecting all engines below 200 horse-power, we note that a classified list of gas-engines in use or under construction shows the remarkable total of 327 gas-engines capable of supplying 182,000 horse-power. This gives an average of about 560 horse-power per engine.

As compared with this we find from the last U. S. Census Report that, during the census year 1899, there were constructed in the United States 18,500 combustion engines having a total capacity of 165,000 horse-power, or only about 9 horse-power per engine.

Although this country has lagged somewhat behind Europe in adopting large gas-engines, there is evidence that this state of affairs will not exist very long, for a number of enterprising firms are already in the field prepared to build gas-engines up to any required size. One firm has already sold over 40,000 horse-power of large engines, most of them of 2,000 horse-power and several of 1,000 horse-power. Another firm has recently built two 4,000-horse-power gas compressors and also a number of 1,000-horse-power gas-engines.

The use to which these large engines are put is about equally divided between the operation of blowing engines for blast furnaces and the driving of dynamos for general power distribution; the tabulated list compiled by Mr. Humphrey for engines of more than 200 horse-power shows 99,000 horse-power for driving dynamos for light and power and 83,000 horse-power for other purposes.

While the gas-engine in the larger sizes is thus used extensively for the generation of electric light and power, a growing tendency is observed to use the gas-engines direct as motors.

A number of railroad and other machine shops have been equipped with moderate-sized gas-engines suitably located about the works, and in addition, thousands of horse-power are used in the smaller sizes for a wide variety of purposes, including village water-works, isolated lighting stations, and manufacturing plants of all kinds.

With the possibilities of high thermal efficiencies we may look with much hope upon the still higher development of cheap fuel gas processes that will bring the gas-engine into very general succession to the electric motor for many purposes, for it will doubtless be found that gas transmitted from a central gas-making plant at a manufacturing works into engines located at points of use will effect a material saving in the utilization of power over any existing methods.

It is not to be presumed that the gas-engine will displace either the electric motor or the steam-engine; each has its legitimate sphere of usefulness, and each will be more highly developed as the result of direct competition. Yet the economies already obtained indicate that the field of the gas-engine will be extended more and more into that of the steam-engine and the electric motor.

Many of the questions involved in this consideration are at the present time in a transitional stage. The reciprocating steam-engine has reached a high state of development, but it is not probable that it has attained its highest degree of perfection. While an economy less than 9½ pounds of steam per horse-power-hour has been obtained, even better results may be anticipated; the use of high pressure superheated steam in compound, jacketed engines involves more perfect lubrication, and this may demand modification in existing valve types; however this may be, the outlook is promising for still higher efficiencies; whether this will mean cheaper power than can be obtained in other ways will depend upon many conditions.

In any case, and especially with intermittent or variable loads, it is not so much a question of maximum efficiency as it is economy of operation.

From this point of view the present activity in the construction and development of the steam-turbine is of interest to en-

gineers and power users. The steam consumption of a modern steam-turbine of moderate size compares very favorably with that of the better class of large reciprocating engines, but what is of greater importance is the evident superior steam economy under variable loads. The steam consumption per horse-power-hour varies little from one third to full load; at overloads the economy, as shown by numerous tests, may be even better.

This feature predestines the steam-turbine to the special field of electric lighting and power generation, where it must inevitably become a formidable rival of the larger-sized slow-speed reciprocating steam-engine.

It is a significant fact that immediately following upon the installation of the large 8,000-horse-power compound steam-engines at the central station of the Manhattan Elevated Railway, New York, we find three 5,000-horse-power steam-turbines under construction for the Rapid Transit Company, of New York.

The high rotative speed of the steam-turbine is a prominent factor in favor of its adoption in connection with electrical generators, since the cost of the generator end of the equipment ought eventually to be very materially reduced; but for many lines of work the high rotative speed of the present types of steam-turbine is prohibitive, nor can it be adapted successfully to belt driving, except by the use of gearing. However, it is fair to presume that the present limitations of the steam-turbine are not insuperable, and that the attention which is now being given to its development will evolve a more universal type of motor adapted to general power purposes with large and small units alike.

The economies already obtained with both the steam-turbine and the gas-engine have brought each into a prominence which is at least suggestive of the important developments that are taking place in methods of obtaining and using power.

JOHN JOSEPH FLATHER.

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*THE PERPLEXITIES OF A SYSTEMATIST.**

A FORMER Chairman of this Section gave utterance in his retiring address to the following frank expression of sentiment: 'So welcome to the old-fashioned systematist, though his day be short, and may he treat established genera gently!'

If this cheerful prognostication is to be realized, the perplexities of the systematist are of short duration at best, or worst, and it were better for us, in view of our impending doom, to come before you to-day with the historic 'Morituri te salutamus,' and then kindly but firmly retire to the oblivion so imminently before us.

But on second thought we find ourselves not at all in the mood to fulfil the expectations of the genial oracle referred to, and, indeed, very much alive and willing to continue in the struggle for existence, although an even worse fate than death is offered as an alternative when the same prophet predicts that 'the future systematic work will look less like a dictionary and more like a table of logarithms.' Of course there is no gainsaying the fact that those who prefer logarithms will have them, but I will also predict that the number who will choose the lesser evil of the dictionary will remain for an indefinite length of time very much in the majority, even if this choice dooms them to the outer darkness where the 'old-fashioned systematists' are to be relegated by the logarithm proposers.

However this may be, certain it is that there will always be need for the men who perform the hard and often thankless task

* Address of the chairman of the Section of Zoology and vice-president of the American Association for the Advancement of Science. Read at the Washington meeting, January 27, 1902.

of the systematist, and those of us who are still pushing forward in spite of the almost overwhelming perplexities of the work, to say nothing of the frankly expressed contempt of the men in whose service we toil, are by no means called upon to sing our 'Nunc dimitis.' It has occurred to me that it would be profitable for us to consider on this occasion the position in which we stand, make confession of our sins, which are many, state as clearly as possible the embarrassments which at times nearly overcome us, and attempt at least to point out some of the means by which we can better our position and our work.

As to our position before the general public, it must be confessed that the general public cares for us not at all. Of all departments of biological science, none offers so little that is attractive to the average man as that which has to do with classification and the host of outlandish names that the systematist delights, in popular opinion, to inflict upon the literature of his subject. The average college student agrees with the general public, and will be prone to elect anything rather than systematic zoology or botany. There is absolutely nothing that seems to him more hopelessly dull, forbidding and profitless than all matters pertaining to classification and nomenclature. But it is in the house of our friends that we are wounded most cruelly. Even the best of our fellow zoologists and botanists wish us nothing better than a speedy and painless, at any rate speedy, death, and the worst of them would be glad to hasten the day.

It is not my purpose to discuss at present the attitude of the general public, nor even that of the college student, important as it is to all of us, but some attention ought surely to be paid to the prevalent opinion of our colleagues.

Let us inquire then, briefly, into the reasons for the unfortunate attitude of these who ought to be our best friends. In my opinion the most fundamental cause for their discontent is to be found in their irritation in finding nothing fixed or definitely settled in our classifications, or even in specific or generic names.

It certainly does not conduce to the tranquility of mind of the morphologist who desires to discuss the variation of a certain structure in a given group of animals to find that his friend the systematist is utterly unable to delimit the group for him, or that no two authorities can agree as to the number of species, much less as to their names! Wishing to get upon some solid ground for his discussion, the morphologist asks in desperation: 'What is a species, anyhow?' And the systematist, if he is honest, is forced to admit that he doesn't know. Again, the morphologist, with a commendable desire to learn something of the classification in a general way, laboriously masters some scheme which seems to have met with general acceptance, only to find that the next authority that he consults scorns it utterly. Still again, wishing to discuss the geographical distribution or ecology of some limited group, he finds that no two systematists agree as to the number of species included or the names by which they should be called.

Now, all this is exasperating to the last degree, and we must deal gently with our friends who exclaim in desperation: 'Is there anything definitely settled in regard to any group of animals whatever?' or 'Have the systematists any real basis for their decisions, or are they anything better than the merest personal whims?' Can we wonder that they resort at times to absolute brutality, and propose logarithms?

Having thus admitted the unfortunate position in which we stand before our fellow zoologists, let us now turn our attention to the highly edifying endeavor to honestly confess our sins. I suppose that

every zoologist who does systematic work starts out with the idea that there is nothing else quite so desirable and altogether ecstatic as the discovery and naming of new species; and this feeling results, it must be confessed, in numerous synonyms and great confusion. That this is an almost inevitable phase in the career of the ambitious systematist must be frankly acknowledged, and must be endured with as much philosophy as possible, the prospect being cheered by the reflection that the phase is exceedingly evanescent, and is of inconsiderable duration as compared with the whole career of the systematist. I know that I shall be backed by every worker of experience when I assert that any systematist who has gotten beyond the callow period would very much prefer to be able to place a given form in a previously described species than to be forced to describe it as new.

Besides, those of us who are sufficiently unregenerate can take great comfort in the thought that no one more eagerly embraces the chance to describe a new species than the morphologist who thinks he has discovered a novelty, and he it is who most often dodges the necessity of careful research along bibliographical lines, and at the same time artlessly evades all proper responsibility for his crimes by the formula: 'If this interesting form proves to be new, I propose for it the following name.'

The naïve innocence of some of our embryo naturalists is sometimes quite refreshing. For instance, a year or so ago a young and enthusiastic student in a western state wrote me that he thought he had a new species of a group in which I am interested, and asked me to kindly send him the literature on that group. Not finding me able to see my way clear to accommodate him, he proceeded to describe the supposed new species, and gave it a name. The result proved that the name was preoccupied and that the species was only a somewhat common color variety of a well-known form.

We have all of us made ridiculous mistakes, however, and no systematist of any experience could afford to throw the first stone were the biblical condition enforced. We should be cautious, however, and not leave too many cracks in our harness to be discovered by our friends the enemy. There are certain things that we ought to stop doing, and stop at once. One of the worst sins of the systematist is inadequate description of species. The scientific world has a right to demand good clear descriptions, and is not slow to express its contempt for any remissness in this direction. As an example of this particular sin I would cite an instance given by an entomological friend, which I quote verbatim:

"The variety harrisii of *Cicindela sexguttata* is described thus: It differs from typical *sexguttata* in the color, which is olivaceous green, and *in living at a considerable elevation.*"* It is not often that the variety maker is so refreshingly frank as this.

Another illustration is furnished by one of our energetic and intrepid young ornithologists, who evidently believes that each geographical locality ought to yield a trinomial for each bird inhabitant. He says:

"The differences characterizing this new form are not such as may be graphically described, but they are, nevertheless, quite apparent on comparison of specimens."

It appears from the context that this subspecies is based on a single specimen, but, coming from a different region, like the 'living at a somewhat higher altitude' of the insect referred to above, seems to be in reality, if not professedly, a zoological character. It seems to your speaker

* The italics are mine.

that a difference that is so elusive that it cannot be graphically described is not a proper basis for even a new subspecies.

The question here arises: Is there any legitimate limit to the refinement of description and niceties of distinctions between species or subspecies? There are many that hold that any difference whatever is sufficient basis for a specific description so long as there is no intergradation with other forms. Now it is evident that differences may be so small that intergradations are practically, although not theoretically, impossible. The keen eye of the expert systematist becomes almost microscopic in its function and sees differences that appear perfectly evident to the observer, but that are really intangible to the general zoologist, to say nothing of the scientific public at large. Should each of these microscopic differences be dignified with a separate name? If so, can we wonder that the non-systematic brother becomes thoroughly disgusted with our discussions of the zoological 'filioque' and consigns us all to quick extinction or a lurid future of logarithms?

It is to be hoped that the future will disclose some method of preserving scientific exactness, and at the same time obliterating the excessive pedantry that at present seems to be the main objective with certain systematists. And there is good biological ground for this hope in the law enunciated by our lamented Cope as the 'law of the unspecialized.' This, he says, 'describes the fact that the highly developed or specialized types of one geologic period have not been the parents of the types of succeeding periods, but that the descent has been derived from the less specialized of preceding ages.' There is no doubt that the extremists have their time and their uses, but they are not likely to be followed in their extreme positions by their successors of coming generations. It may be confidently predicted that the future will disclose a safe mean between the lax methods of many of the older zoologists and the indefensible hair-splitting of the extremists among the so-called advanced systematists of to-day.

In the estimation of the general scientific public the most grievous of our sins is the making of synonyms, and there is no question that we have much to answer for in that direction. There are few, however, that are in a position to realize the difficulties, amounting almost to impossibilities, that confront even the most conscientious worker. He has in hand a form that he cannot place in any known species, although he would be saved a deal of trouble if he could. He must call this troublesome animal something. He cannot call it by an old name and so, perforce, he must find a new one for it. It belongs to an old and well-established genus to which hundreds of species have, in the course of more than a century, been referred. Every descriptive term that can possibly be made to apply to such an animal has long ago been used. Though the worker may live in some great library center, such as Boston or Washington, it is impossible for him to have access to all of the literature pertaining to even a limited group. Though he spend months in looking through dealers' lists and catalogues, he is bound to miss a number of papers any one of which may contain matter vital to his purpose. Having exhausted every available source of information, he at last ventures to decide on a name which seems to him to be apt, and not preoccupied. The more experienced he is as a systematist the less confidence he has that his name will stand, nor is he greatly surprised to be reminded by some loving friend that that name was used twenty years ago in a paper published in

Russian and issued by a local scientific society in Kamchatka.

To illustrate the hopelessness of consulting all of the literature on even the most limited subject I will venture on a bit of personal experience.

For the past ten years I have earnestly endeavored to consult all of the papers regarding a very small group of animals in which I am particularly interested. In addition to buying everything that was mentioned in numerous lists and catalogues from the best European book dealers, the libraries of Harvard, the National Museum, the Congressional Library, the private library of Dr. Agassiz at Newport, the library of the Naples Zoological Station and other famous libraries in Europe were faithfully consulted and a card catalogue of every reference to a species included in the group under consideration was made. After which it seemed that I could at last work with some confidence that nearly all of the possible synonyms were where I could get at them when wanted. A few weeks ago the mail brought me a paper published in Geneva, in which occurred no less than one hundred titles of papers relating to the group of animals in which I had been working, not one of which I had been able to find.

Now if it is so difficult, nay impossible, for one who has access to a number of the best libraries to feel confident of avoiding the creation of synonyms, how can we expect the young worker with access to only a few books to avoid the same catastrophe? Of course it is easy to say that he has no business to attempt systematic work, and perhaps we should be justified in such a remark. But, after all, our position would be sadly like that of the historic mother who forbade her daughter to go near the water until she had learned to swim.

There is a distinct danger in attempting to restrict systematic work to those exceptional persons who have access to first-class libraries. Thoroughly equipped systematists will be needed in the world for a long time to come, in spite of frankly expressed views to the contrary, and the ranks of those passing away must be filled by competent men. Such men must be supplied mostly from our colleges and universities, and it is futile to expect the few institutions having adequate libraries to turn out a sufficient number of men to do this work.

As a matter of fact, the very universities that are in the best position to do such work are the ones that offer the least encouragement to the would-be systematist. In my opinion, our best-equipped universities are falling far short of their proper function in not paying more serious attention to this part of biological science. Some time ago I received a letter from a zoologist holding a high position in one of our largest museums, in which he complained that, while they were able to find plenty of young men who could work out the histology of a definite organ, or the embryology of a species, or undertake experimental work, there was only one university that he knew of, and that a western one, that gave students the training that was necessary to make them competent to work up a collection. For years there have been waiting for suitable men the vast accumulations of material in our great museums, and it is impossible to find men able to work up some of the most important groups.

Such, then, is the situation. There is the most urgent need for competent systematists, and our universities, the natural source of supply, are doing next to nothing in the way of training men for this important work.

But the objection may here be raised that the systematist is a specialist of a kind that cannot be trained for his work in the ordinary university course.

Of course it is impracticable to turn out full-fledged systematists, but it is practicable to give men the kind of education that will enable them to take up systematic work to advantage after their college days have been completed. The mental or intellectual equipment needed by the systematist includes three prime requisites: (1) accurate observational power, (2) a well-trained and reliable power of discrimination, and (3) the power to describe accurately and in good English. Now, be it observed that these three accomplishments are the very ones that are the most valuable intellectual gifts in almost any walk in life, and hence it follows that that sort of education which turns out good timber for systematists is the very one that serves the best and most useful pedagogical purposes; and the plea which I here make for more attention being paid by our colleges to preparing men for systematic work, is at the same time a plea for the best and strongest preparation for almost any walk in life.

It will, of course, be conceded that the first of the requisites cited above, namely, accurate observational power, is the primary aim of work in all material science; and it will also be conceded that the education of the power of discrimination or judgment is also included in any thorough scientific work; but I do not believe that any other branch of biological science does so much toward evoking fine descriptive power as does systematic work, either in botany or in zoology. After an experience of some seventeen years as a teacher of science, it is my deliberate judgment that good descriptive ability is much more rare than the ability either to observe or to discriminate, which is really a part of observation. It would be laughable, were it not pathetic, to see the utter helplessness of even the better class of university students when they are told to describe even the simplest object. Time after time I have found that a class of twenty or more sophomores did not contain a single one who could really describe any definite object with even approximate success. But it is a never-failing delight to see the power that they can acquire in this direction after a year of faithful work along systematic lines.

Teaching of the sort that I have indicated need not be confined to the largest and best-endowed colleges. Fairly large collections in certain definite groups are a necessary prerequisite, but such collections can be secured at less expense than the laboratory equipment that includes a good compound microscope for each student, and in many cases the teacher can, with the help of students, make suitable collections in such groups as birds and insects.

The whole scheme of systematic arrangement lends itself admirably to the gradual evolution of descriptive power. Commencing with the larger groups, the student is drilled in discriminating the broader characters, such as differentiate classes and orders, for instance; then closer work is required in studying the families. Lastly, some few families are taken up and the work becomes focused on the fine discriminations required in describing genera and even species.

In the University of Iowa, for instance, the student works for one third of a year on the classes and orders of the lower invertebrates. Then he studies the groups of mammals, down to and including the families, for an equal length of time, the remainder of the collegiate year being devoted to the study of birds, more than half of this latter period being given to a careful study of the Passeres. The work is focused more particularly on birds because the university museum is particularly well equipped in birds, they are

pleasing objects of study for most students, and they are particularly available for illustration in such objects as coloration, geographical distribution and, strange as it may seem, ecological problems.

You will pardon me, I hope, for thus intruding the work of my own department upon your attention. But it serves to illustrate my meaning in claiming for systematic work the highest grade of pedagogical value. It does teach the student to observe carefully, discriminate with something of that judicial nicety so rare and so helpful in any life, and lastly—and it seems to me that this is the crowning achievement in education—to describe accurately not only from a scientific but also from a literary standpoint. Lucidity and accuracy of language accomplishes marvels in the way of inciting to lucidity and accuracy of thought, and, so it seems to me, actually precedes them in time.

All this may seem a digression from the main theses of my address, but it will be remembered that we are trying to find a remedy for the scarcity of men competent to occupy the field of systematic work, and the first thing needful is a realization on the part of our colleges and universities that they have too long neglected the educational value of training along systematic lines. Were they led to recognize this at its just value, it would be provided for on at least an equal footing with morphology in the curricula of all reputable colleges, and this would result in the graduation, yearly, of a number of young men and women who have the preliminary training that will enable them to take up systematic work in earnest.

Of course this real systematic work can only exceptionally be done in colleges. Not even as post-graduate work can it be attempted, save under circumstances seldom realized. But the men, if worthy, will find the place to work in centers where great museums and libraries will be at their command. In this connection the thought forces itself to the fore that the great and greatly discussed Carnegie Institution can do a most important work in seeing to it that such young men, equipped particularly for systematic work, can receive enough of a stipend to feed and clothe them while necessarily away from home and doing important systematic work in overhauling and bringing order out of the chaos that prevails in most if not all great museums, where a wealth of material has been allowed to accumulate for decades awaiting the time when the right man can come to the aid of overworked curators and intelligently and efficiently disentangle the all but hopeless masses of material, and, with keen insight and trained powers of description, successfully trace the obscure web of relationships and of descent. Thus the curators will be left free to do better and more worthy work along the lines of their chosen studies, relieved of at least a part of the all but intolerable burden under which they are staggering, and in spite of which so much excellent work has been done.

While no one more heartily condemns scientific provincialism than does your speaker, still we can rightly indulge the hope that the time will come, and that soon, when it will be unnecessary to send to Europe for men competent to report on collections made by our government expeditions, and when collections will be entrusted to American zoologists, *not* because they are American, but because they are best able to do the work in a satisfactory manner.

It is probable that nine out of ten systematists, if asked what, in their opinion, was the most thankless and wearying part of their work would unhesitatingly answer, 'The bibliographic work.' In nothing are our energies so wastefully and often need-

lessly expended. Now that the Congressional Library is at last in working order, it seems to me that it ought to be possible to undertake a work in this direction that would be not only an unspeakable boon to all who are engaged in systematic investigation, but also to the scientific public at large; for nothing that I can think of would go so far towards reducing the pernicious activity of the maker of synonyms to a minimum as a methodical and exhaustive publication of bibliographies in connection with which synonyms* would be promptly 'spotted' and reported at once to the scientific world.

Our Congressional Library is worthy of a nation's pride. Having had occasion to work there myself, I can say that nowhere can better service or more helpful courtesy be found than is accorded one who desires to do serious work within its walls. One must use it before he can form any just idea of the wonderful change that has been brought about since the present building was completed. Here is undoubtedly the best place in America to do bibliographic work, and here could be undertaken a public service that would be second to none in helpfulness to the naturalist, the systematic publication of bibliographies, perhaps following the general lines of the Concilium Bibliographicum, which has already rendered invaluable service, so far as current publications are concerned.

The Concilium Bibliographicum, however, can furnish but little help regarding publications of other than comparatively recent date, and this is the most pressing need of the systematist. This task, colossal as it is, could be accomplished if attacked systematically by a sufficiently large force of competent workers. It would not be necessary to complete the work in any group before the results could be available for general use. By a periodical mailing of cards some relief could very shortly be extended to all those who are known to be interested in any group, and as the history of our science covers less than a century and a half, a vigorous prosecution of the work would enable us to have authentic and reasonably complete bibliographies brought up to date within a very few years.

Such work need not, indeed should not, be confined to bibliographies of publications, but should include bibliographies of specific names. Every reference to a species should be given a separate card. These could be arranged both alphabetically and chronologically, and when such a bibliography is completed up to date a synonym can be detected with unerring accuracy. I speak from some little experience when I say that such an arrangement of cards is the greatest possible assistance and time-saver, as I have myself made a card bibliography of a single order of animals with which I am working. It includes some six thousand cards, and involves a card catalogue of authors, with their publications, of families, of genera and of species.

Of course such a plan as has been indicated could only be carried out by a corps of specialists, each having immediate charge of the work pertaining to some limited group, and the whole should be under the supervision of some public scientific organization such as the Smithsonian Institution, or possibly the Washington Academy of Science; such bodies being particularly available on account of their being situated in Washington, where most of the actual work would be done.

But what answer shall we give to our friends who plaintively implore us to 'deal gently with established genera'? It is in connection with this question that we are

* The word synonym is here used in its more general sense, including both autonyms and synonyms in a strict sense.

confronted with some of the most perplexing of our difficulties. How far are we justified in overturning that which is firmly established by usage in order to introduce schemes of classification that seem to us better and more rational?

Hoping that your patience has not been exhausted by the references already made to personal experiences, I beg your indulgence while I refer once more, for illustration, to my own work, which is a monographic treatment of an order of cœlenterates. In attempting to discuss the genera of a single family, the Sertularidæ, it was found that there were included in it about twelve apparently well-established genera. These had been carefully defined and the classification seemed a logical and good one. When, however, the great amount of sertularian material accumulated during the past twenty years by the *Albatross* and other government agencies, together with the results of recent work by our cousins across the water, came to be worked over, the fact became more and more apparent that not a single one of these established genera could hold, unless some entirely unnatural and arbitrary characters were used, such as would be employed in the construction of artificial keys. Not a single one of these genera, as defined, was exempt from almost ideal intergradation with one or more other genera. Here the investigator is confronted with a dilemma with several horns, if the bull be allowable, either one of which was fraught with most uncomfortable consequences. The following courses were open:

1. To adopt an entirely artificial system, for convenience only.

2. To throw all of the old genera into one, for the sake of scientific consistency.

3. To make a new grouping, involving a new lot of genera.

4. To use the old and well-established genera, pointing out the intergradations and frankly admitting their scientific insufficiency.

Considering these in order, we find that the first proposition, that is, to adopt an entirely artificial system for convenience only, would be eminently unscientific, a backward step that should not have serious consideration.

To throw all the old genera into one would be the course to which the strict dictates of the scientific conscience would impel the investigator. If one could set aside every consideration save the letter of the law, and be willing to be pilloried by his colleagues, this would be the proper course to pursue. As a matter of fact, however, such a course would involve the renaming of about nine tenths of the hundreds of species involved, and throwing all the knowledge so laboriously attained by our predecessors and contemporaries into pi, resulting in every worker in that group, or every one that wanted to mention a species, being forced to find out what the thing would be called under the new system, no matter how familiar he might be with the group. Should any one have the hardihood to precipitate such a disaster, he would not only be pilloried and execrated, but, I doubt not, would fail to secure a single follower, and all of his work would die with him and his name be anathema.

The third course, that is to make a new grouping under new generic names when necessary, and old ones when possible, would be an excellent solution were it not for the fact that months of the hardest study, with ample literature and material hitherto unsurpassed in abundance has resulted in the sad conclusion that no grouping can be devised that will not be open to the original difficulty, that of intergrading forms in all directions. Nothing would be gained, and much confusion

would result from this course, which, like the others, cannot wisely be adopted.

There remains then but one suggestion. That is to use the old and established genera, which will work in perhaps ninety-five per cent. of the cases, and frankly call attention to the intergradations so that no one will be misled.

In this way we can heed the pleading of our friends to 'deal gently with established genera,' and not bring disastrous confusion into the already overworked synonymy.

Of course this solution is far from ideal, and will doubtless meet with no little criticism, but it is an honest one, and it is hoped will meet with the gratitude of those who plead with us to 'deal gently with established genera.'

It is to be feared that we have been too lenient with those who have been heedless in the matter of overturning existing classifications before they are certain that they have something better to offer. The old proverb, 'Be sure you are off with the old love before you are on with the new' is one all too apt to be forgotten by the enthusiasts who are unable to distinguish the difference between becoming great and becoming notorious. A little wholesome conservatism is by no means to be despised. A system of classification is not necessarily better because it is new, and we need to redeem ourselves from the charge, all too well founded, that we are capricious in tinkering with matters that need the most careful pondering, and an application of Davy Crockett's motto, 'Be sure you're right, and then go ahead.'

Of course all real progress must be encouraged, and it will never do to allow considerations regarding public, or even scientific, opinion to deter us after we are sure we *are* right. Conservatism by no means means stagnation, but it does mean deliberation.

But I have already trespassed too long upon your time without even touching on several questions of vital importance, such as the 'A. O. U. Code,' the best medium of publication, an authoritative tribunal for the settlement of such questions of nomenclature as could rightly be submitted to such a body, and other matters that I had hoped to discuss.

In conclusion, let me urge the necessity of hearty cooperation and a good understanding between systematists and other workers in the field of biological research. None of us can afford a contemptuous attitude toward any other who is honestly striving to extend the limits of knowledge, even though his faults are many. In early days out West there hung in a popular dance hall the suggestive notice: 'Don't shoot the orchestra. He's doing the best he knows how'! The same plea in thought, if not in language, we would enter in behalf of the systematist.

C. C. Nutting.

SCIENTIFIC BOOKS.

Geschichte der Chemie und der auf chemischer Grundlage beruhenden Betriebe in Böhmen dis zur Mitte des 19 Jahrhunderts. Von Adalb. Wrany. Prag. 1902. 8vo. Pp. vii + 397.

Dr. Wrany's volume deals with the progress of chemical science and its allied industries in the kingdom of Bohemia from the earliest times to a comparatively recent period, in an exhaustive manner. The first section considers the development of alchemy, it being a part of the history of civilization; it records that the first Archbishop of Prague, Arnest von Pardubic, who became chancellor of the newly founded University of Prague, attended universities in Italy to study chemistry and alchemy; he died in 1364, being a century later than Roger Bacon, Albertus Magnus, and the noted physician Arnold de Villanova, but preceding Paracelsus by an equal number of years. The first Bohemian writer on alchemy was Johann von Tetzen, whose verses

on the philosopher's stone are dated 1412. The first person of high rank to practice alchemy was the Empress Barbara (wife of Emperor Sigismund, 1451) who acquired a high reputation.

The second section deals with the beginnings of pharmacy in Bohemia. Up to the end of the fifteenth century the art of the apothecary was chiefly connected with the merely mechanical preparation of drugs, but when iatro-medicine began to develop, chemical processes and medicaments acquired an important place in pharmacy; a certain Master Bandinus de Aretio (Aretino = Arezzo) is named as apothecary to Prague in a manuscript of the early part of the fourteenth century.

This second section contains an interesting and useful table giving the names by which a large number of pharmaceutical preparations were commonly known in the years 1585, 1699, 1750 and modern times (besides several intermediate years), which shows that Bohemia was little behind other nations in introducing chemistry and chemical nomenclature into pharmacy.

In the succeeding sections the author treats of the metallurgy and the technological industries of the sixteenth, seventeenth and eighteenth centuries (III.); of chemistry in educational institutions (IV.); of scientific researches and publications in the past one hundred and fifty years (V.), and progress made in all branches of chemistry up to the middle of the nineteenth century (VI.).

At the University of Prague the professor of botany gave the instruction in chemistry in accordance with the statute of 1654, and it was not until 1745 that a committee appointed to reorganize the curriculum reported in favor of establishing an independent chair, which was done the following year by the installation of Johannes Antonius Scrinci, the first professor of chemistry and physics in Bohemia. Scrinci at once gathered a quantity of apparatus, etc., at his own expense, and opened public lectures which attracted students from all parts of Bohemia as well as from adjoining nations. Among his successors should be named Josef von Freysmuth, who was the first professor of general and pharmaceutical chemistry in 1812; under him modern rooms and fittings were introduced, but he died at the early age of thirty-three. Among the Bohemians who became eminent in chemistry may be named Plischl, Lerch, Balling (1805–1868), noted for his treatise on fermentation and his work on sugar, and lastly Ammerling (1807–1884).

A comment of the author is true of other nations than Bohemia; he writes: 'Analyses made in the eighteenth century, as late as the second half, have only historical value.' This remark is made apropos of examinations of the many mineral springs, whose healing qualities early attracted attention.

In the last section of this comprehensive and carefully arranged work Dr. Wrany discusses the introduction and growth of the coal industry, of assaying, of iron smelting, of the extraction and refining of the precious metals (especially in Joachimsthal), as well as the metallurgy of lead, mercury and other heavy metals. Nor does he neglect the historical aspects of the industries peculiarly connected with chemistry, as the manufacture of ink, of matches, of dyestuffs, of glass, keramics, sugar and of the brewing of beer.

The volume is full of details not found elsewhere, and made accessible by an author and a subject index separately (why divided?).

Dr. Wrany is already known by his work on mineralogy in Bohemia, from a historical point of view (1896), but he has not survived the publication of the book under review. This book is clearly printed on good paper, but so wretchedly sewn (two stitches placed close together) that only with the greatest care in handling has it survived the examination made for this review, and it goes immediately to a bookbinder.

HENRY CARRINGTON BOLTON.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

THE annual meeting of the New York Academy of Sciences was held at the American Museum of Natural History on Monday, December 15, at 8:15 P.M., President J. McKeen Cattell presiding.

The reports of the officers for the past year were presented, dealing with the work of the academy since the last annual meeting, on February 24. During this period, twenty-three meetings of the academy have been held, at which forty stated papers and four public lectures were presented. There are three hundred active members, of whom ninety-six are fellows. Among the important changes during the year mentioned was the decision to publish articles accepted by the publication committee as separate brochures, to be collected at the end of the year, and bound up with the proceedings. An entire formal reorganization, furthermore, has been effected. By the passage of a legislative act last winter granting increased powers to the academy, it has been possible to adopt a new constitution and new by-laws to suit the present needs of the academy. Many minor changes have therefore been made in details of organization, terminology and procedure. An event of considerable importance to the academy has been the change in place of holding meetings to the American Museum of Natural History.

No publications have been brought out, owing partly to lack of funds. As, however, the treasurer's report shows a much more prosperous condition of the academy, it is expected that publication will be resumed. The library, still in Schermerhorn Hall, Columbia University, has been carefully maintained, special efforts having been made to fill gaps in serial publications of value.

The following active members were recommended by the council for election as fellows, because of their scientific attainments or services, and their election followed:

Professor Edward F. Buchner, Clark University, Worcester, Mass.

Miss Esther F. Byrnes, Ph.D., Girls' High School, Brooklyn.

Dr. R. H. Cunningham, 200 West 56th Street.

Professor Albert W. Chester, 39 College Ave., New Brunswick, N. J.

William Dutcher, 525 Manhattan Ave.

Dr. Harrison G. Dyar, U. S. National Museum, Washington, D. C.

Dr. George I. Finlay, Columbia University.

John Eyerman, Easton, Pa.

Professor William J. Gies, College of Physicians and Surgeons, 537 W. 59th St.

Professor Amadeus W. Grabau, Columbia University.

Dr. John D. Irving, U. S. Geological Survey, Washington, D. C.

Dr. Gustav Langmann, 121 West 57th St.

Dr. H. R. Linville, DeWitt Clinton High School, 174 W. 102d St.

Professor J. E. Lough, School of Pedagogy, New York University.

Professor R. MacDougall, School of Pedagogy, New York University.

T. Cumerford Martin, The Monterey, West 114th St.

Dr. Adolf Meyer, Pathological Institute, New York City.

Dr. S. A. Mitchell, Columbia University.

Herschel C. Parker, Columbia University.

Dr. Frederick Peterson, 4 West 50th St.

J. C. Pfister, Columbia University.

Professor John D. Prince, 31 West 38th St.

Dr. H. G. Piffard, 256 West 57th St.

Professor Michael I. Pupin, Columbia University.

Dr. Ivan Sickels, 17 Lexington Ave.

Professor M. Allen Starr, 5 West 54th St.

George T. Stevens, M.D., 22 East 46th St.

C. A. Strong, Columbia University.

Dr. F. B. Sumner, 17 Lexington Ave.

Professor W. Gilman Thompson, 34 East 31st St.

C. C. Trowbridge, Columbia University.

Professor John F. Woodhull, Teachers College, West 120th St.

E. R. Von Nardroff, 360 Tompkins Ave., Brooklyn.

The annual election of officers was then held, and the following were chosen:

President, J. McKeen Cattell.

Vice-Presidents, Section of Geology and Mineralogy, James F. Kemp; Section of Biology, Bashford Dean; Section of Anthropology and Psychology, E. L. Thorndike; Section of Astronomy, Physics and Chemistry, C. L. Poor.

Corresponding Secretary, R. E. Dodge.

Recording Secretary, H. E. Crampton.

Treasurer, C. F. Cox.

Librarian, Livingston Farrand.

Editor, C. L. Poor.

Councilors: (three years) Franz Boas, Hermon C. Bumpus; (two years) D. W. Hering, N. L. Britton; (one year) E. B. Wilson, George F. Kunz.

Finance Committee, John H. Caswell, John H. Hinton, C. A. Post.

Vice-president Kemp was then called to the chair, and the president delivered his annual address, entitled 'The Academy of Sciences.' At its close a vote of thanks was carried, on the motion of Professor E. B. Wilson. The academy then adjourned.

HENRY E. CRAMPTON,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

NOTES ON NEGRO ALBINISM.

LAST spring, while engaged in archeology work in Coahoma County, Mississippi, I noticed some negro albino children hoeing in a cotton field. The fact that there was more than one in the family led me to make inquiry which brought out the following facts. The grandfather of these children was an albino. He married a normal negro woman and had three normal sons. All three sons married. Two have had only normal children; but the third, who has been twice married, is the father of fifteen children, four of whom are albinos. The first wife had five normal children and one albino; the second, six normal ones and three albinos. I was unable to learn anything about the ancestry of these women.

The particular interest in the case is that the anomaly reappears in one of three lines of descent in the third generation. According to Mendel's law of heredity, we should not expect it to reappear at all. Yet, if we suppose that albinism was recessive in the mothers of these albino children, the observed result is just what we should expect.

These albinos, two of whom have attained full stature, and others in the vicinity, are noticeably taller and have broader shoulders than their normal fellows. Are these accompanying characters?

WILLIAM C. FARABEE.

NOTE ON MR. FARABEE'S OBSERVATIONS.

MR. FARABEE has kindly shown me the proof of his interesting 'Notes on Negro Albinism,' and generously consents to the publication of the following note with his own.

The point needs emphasizing that albinism in mammals in general is a *recessive character* in the sense of Mendel's law. Mr. Farabee writes as if this fact were generally recognized, but I doubt whether this is so. Last winter in my lectures on heredity, which were attended by Mr. Farabee, I showed from the statistics published by von Guaita in 1900 that albinism in mice is a recessive character. This result has been confirmed by Mr. G. M. Allen, who has been carrying on breeding experiments with mice, under my direction, for the past two years. Some results of Mr. Allen's work have been in manuscript for several months, but their publication has been unavoidably delayed. Meanwhile Bateson (1902), in two recent important papers on heredity, has made the first published recognition of the fact that albinism in mice is a recessive character.

During the last few months I have been able to demonstrate experimentally that albinism is a recessive character likewise in guinea-pigs and rabbits. Mr. Farabee's observations indicate that the same is true also in man. It is probable, therefore, that this is a general law of heredity in all mammals. But Bateson has shown that in certain crosses among poultry white plumage is a *dominant* character; consequently we must apparently limit our generalization for the present to mammals. Yet it should be pointed out that the white breeds of fowls used by Bateson in his experiments are not pure albinos, since the eyes, at least, of white birds are pigmented. Consequently we must exercise caution in generalizing from those experiments.

In the case of negro albinism observed by Mr. Farabee, the result is throughout a Mendelian one, on the hypothesis that albinism is recessive. For the original male albino married to a normal negro woman should have only normal offspring, in whom, however, *the albinic character is recessive.* The recorded observation is three sons, all normal.

Two of the sons, apparently, married wives who were 'pure dominants,' *i. e.*, who were entirely free from the recessive (albinic) character. The theoretical expectation in such cases is that half the offspring will be

pure dominants, and the other half dominants in whom the recessive character is latent; but both sorts will be alike (normal) in appearance, as actually observed.

The third son appears to have married each time a woman in whom the albinic character was recessive. The probability of such unions is indicated by Mr. Farabee's observations of *other albinos 'in the vicinity.'* For to every albino produced, where crossing with normal individuals takes place, there are certain to be produced *at least twice as many* 'normal' individuals containing the recessive character. If, as supposed, the third son and each of his wives contained the recessive character, we should expect one in four of their offspring to be an albino; the recorded observation is four in fifteen, a close approximation to the calculated result.

W. E. Castle.

Zoological Laboratory, Harvard University,
December 16, 1902.

MAGAZINE SCIENCE.

To the Editor of Science: The following letter from Mr. C. E. Borchgrevink, in regard to the criticisms published by me in Science of September 13 on the captions of the illustrations of his article on the eruptions of Mt. Pelée which appeared in *Leslie's Monthly* for July, has just been received. In justice to the author, I trust that you will publish this extract from his letter in your columns.

"From a correspondent I hear that you have made an attack on me based upon the article published in *Leslie's Monthly*. I am not responsible for those statements or for those errors in regard to photographs, which never met my eye before they appeared in *Leslie's Monthly*. Very few of those photographs came from my hand and I never of course claimed them."

E. O. Hovey.

SHORTER ARTICLES.

AGGREGATE ATAVIC MUTATION OF THE TOMATO.

On former occasions I have described two remarkable cases of aggregate phylogenetic mutation of the tomato which occurred suddenly under my personal observation, in which publications* I used the term mutation in the special sense that has been adopted by Professor De Vries. The following remarks refer to reports that have reached me from correspondents concerning equally sudden and complete atavic reversion of similar plants and their fruit, for which process I here use the term mutation in its ordinary sense. While the main fact of atavic mutation is clearly stated in these personal reports, they are wanting in certain details necessary to a fuller study of the subject. They are, however, important as aids in an interesting line of inquiry.

In May, 1902, I received from Mr. H. J. Browne, of Washington, D. C., who was then in Havana, Cuba, on business, a package containing a cluster of small spherical tomatoes of the variety known as the Cherry tomato. An accompanying note informed me that they were obtained from the proprietor of a plantation a few miles from Havana who had grown them there, and who assured Mr. Browne that they were the immediate product of seed of the large and fine variety well known throughout our country as the Trophy. These Trophy seed were obtained from the United States and planted in Cuba. The resulting crop of fruit was excellent and perfectly true to that variety as regards size, color, consistence and edible quality; but the seed of those Cuban-grown Trophy tomatoes invariably produced there the small cherry variety. The planter further stated that essentially the same result occurred in the case of all the several other improved varieties of tomatoes, the seed of which he had also procured from the United States, and that the degeneration was in all cases complete, heritably permanent and of uniform character; and that the change equally affected the whole crop. Because of this constantly occurring and hereditary atavism the planter was obliged to procure fresh seed from the United States for every acceptable crop of tomatoes grown on his Cuban plantation.

Quite independently of the foregoing statement I lately received a similar one from Miss Mary E. Starr, of Morristown, N. J. Her observations were made upon her father's plantation on the Bayou Tèche, St. Martin's

* Science, November 29, 1901. *Bull. Torrey Bot. Club.*, August, 1902.

Parish, Louisiana. The father there planted the seed of a choice variety of tomatoes which were obtained from the former family home in New York state, the first crop of fruit from which was perfectly true to seed. He was, however, then informed by a neighbor who had lived in that region many years that, to produce good fruit, seed must be obtained from the North for every year's planting, because all the seed of tomatoes grown in that southern region would produce the small, spherical, inferior fruit, from whatsoever improved variety the seed may have originally come. The neighbor's advice was taken, northern seed was annually procured for future crops, and the first crop of resulting fruit was in all cases as characteristic of its variety as if the plants had grown in their native northern soil. But the truth of the reputed atavic mutation was afterward repeatedly demonstrated on the Bayou Tèche plantation under Miss Starr's observation by growing and maturing plants from seed of fruit which was grown there from northern seed. The permanence of the atavic mutation was also demonstrated by hereditary constancy in successive generations; and its completeness was shown in every plant of the second southern crop from northern seed, as well as in all subsequent crops.

These two cases are stated so clearly by my correspondents, and agree with each other so closely as to the main facts, that one cannot doubt their genuineness. One also cannot doubt that many other similar cases are constantly occurring in various regions, the details of which are not publicly reported. This article is written in hope of eliciting such information of similar cases as shall materially aid further investigations. Reports of such cases should embrace detailed statements concerning attendant horticultural and local climatic and other conditions, and mention of the several varieties whose mutations are observed. The interest attending a consideration of the varieties involved in mutations may be illustrated by the cases of phylogenetic mutation before referred to. In those cases the mutative act was accompanied by the production of one specific form from another, and it is desirable to know if, in cases of atavic mutation like those just mentioned, the reversion may be direct from a specific form that has thus arisen. For example, in those phylogenetic cases the mutation was from *Lycopersicum esculentum* to *L. solanopsis*, and the discovery of a case of atavic mutation involving a retrograde change from the latter species to the former without retracing the varietal steps of the genetic line would, therefore, be of interest in connection with the theory that such mutations originate in molecular changes. In the case reported by Mr. Browne mutation was only varietal or intraspecific in its scope. That is, it was within the species *L. esculentum* because both the Trophy and Cherry varieties belong to that species, and I do not now know whether such atavic mutation as occurred in the cases here mentioned has ever been interspecific in scope, that is, from one species to another.

Cases of atavic reversion of fine varieties of tomatoes are well known to gardeners, but those are generally cases of varietal degeneration complicated by hybridization. In the cases reported by Mr. Browne and Miss Starr, respectively, mutation seems to have been sudden, complete and aggregate for the whole crop. It is, therefore, improbable that it was a result of hybridization in either case. If those northern seeds had been sown in their native soil one cannot doubt that their progeny would have been true to seed in successive generations. Therefore, one also can not doubt that the exciting cause of those atavic mutations was local for the regions in which they respectively occurred. In those cases of phylogenetic mutation which have been referred to, the initial step evidently occurred in the seed of the fruit of the Acme variety which I had myself grown from authentic Acme seed. So also in the cases of atavic mutation herein mentioned the initial step seems certainly to have occurred, not in the somatic cells of either root, stem, leaves or pericarp of the first crop of plants grown in southern soil from northern seed, but only in the germ cells of those plants. In subsequent generations, however, mutation extended to the pericarp, that is, to the fruit; but the

reports which I have received do not state whether any correlated change occurred in the foliage, stems or other feature of the plant's habit. It is, therefore, plain that one cannot satisfactorily discuss the nature of those cases of atavic mutation until more complete data are obtained. Still, one seems to be justified in assuming that the exciting cause of atavic mutation in those two cases is largely connected with climatic conditions, although the determinate cause of mutation, both phylogenetic and atavic, is apparently often independent of such conditions. It may be added that I have not yet been able to suggest an exciting cause for the cases of aggregate phylogenetic mutation which I have referred to; but the facts of that mutation are absolutely as I have stated them in the publications mentioned in the foregoing footnote.

Charles A. White.

Smithsonian Institution,
December 30, 1902.

CARNEGIE INSTITUTION OF WASHINGTON.

APPOINTMENT OF RESEARCH ASSISTANTS.

It is the purpose of the Carnegie Institution of Washington, among other plans, to encourage exceptional talent by appointing a certain number of research assistants.

These positions will not be those commonly known as fellowships or scholarships; nor is the object of this provision to contribute to the payment of mechanical helpers or of assistants in the work of the institution. It is rather to discover and develop, under competent scrutiny and under favorable conditions, such persons as have unusual ability. It is not intended to provide means by which a student may complete his courses of study, nor to give assistance in the preparation of dissertations for academic degrees. Work of a more advanced and special character is expected of all who receive appointment.

The annual emolument will vary according to circumstances. As a rule, it will not exceed $1,000 per annum. No limitations are prescribed as to age, sex, nationality, graduation or residence. Appointments will at first be made for one year, but may be continued.

It is desirable that a person thus appointed should work under the supervision of an investigator who is known to the authorities of the Carnegie Institution to be engaged in an important field of scientific research, and in a place where there is easy access to libraries and apparatus—but there may be exceptions to this.

Applications for appointments may be presented by the head of, or by a professor in, an institution of learning, or by the candidate. They should be accompanied by a statement of the qualifications of the candidate, of the research work he has done, and of that which he desires to follow, and of the time for which an allowance is desired. If he has already printed or written anything of interest, a copy of this should be enclosed with the application.

Communications upon this subject should be distinctly marked on the outside envelope, and on the inside, Research Assistant, and should be addressed to the Carnegie Institution of Washington, 1439 K Street, Washington, D. C.

MARINE BIOLOGICAL LABORATORY.

The Carnegie Institution of Washington has made a grant to the Marine Biological Laboratory and now has at its disposal twenty tables in the Laboratory at Woods Hole, Mass., for the season of 1903. These tables are intended for the use of persons engaged in original research in biology, and carry with them the right to be furnished with the ordinary supplies and material of the Laboratory. Applications for the use of one of these tables should be addressed to the Secretary of the Carnegie Institution, Washington, D. C., stating the period for which the use of the table is desired, and the general character of the work which the applicant proposes to do.

SCIENTIFIC NOTES AND NEWS.

The American Society of Naturalists at its Washington meeting during convocation week elected as president Professor William Trelease, of the Missouri Botanical Garden. Dr. Franz Boas, of New York, was elected vice-president and Professor Bashford Dean, treasurer. Dr. G. Ross Harrison was reelected secretary. Professor William T. Sedgwick,

of the Massachusetts Institute of Technology, and Professor J. McKeen Cattell, of Columbia University, were elected additional members of the executive committee. The time and place of the next meeting of the society were referred to the executive committee in consultation with the secretaries of the affiliated societies, but will doubtless be at St. Louis in conjunction with the meeting of the American Association for the Advancement of Science.

PROFESSOR J. H. LONG, of Northwestern University, was elected president of the American Chemical Society, in succession to President Ira Remsen, of the Johns Hopkins University.

AT the annual meeting of the American Mathematical Society the following officers were elected: *President,* Professor Thomas S. Fiske, Columbia University; *Vice-Presidents,* Professor W. F. Osgood, Harvard University, Professor Alexander Ziwet, University of Michigan, Professor D. E. Smith, Teachers College, Columbia University; *Secretary,* Professor F. N. Cole, Columbia University; *Treasurer,* W. S. Dennett. *Librarian,* Professor D. E. Smith; *Committee of Publication,* Professor F. N. Cole, Professor Alexander Ziwet, Professor D. E. Smith; *Members of the Council,* Professor James Harkness, Bryn Mawr College, Heinrich Maschke, University of Chicago, Irving Stringham and W. H. Tyler.

MR. WILLIAM LUTLEY SCLATER has been selected by the council of the Zoological Society of London to succeed his father, Mr. Philip Lutley Sclater, as secretary of the society. Mr. Sclater holds the position of director of the South African Museum at Cape Town.

MR. WILLIS L. MOORE, of the U. S. Weather Bureau, and M. C. A. Angot, of the Central Meteorological Bureau of France, have been elected members of the Royal Meteorological Society.

DR. J. WIESNER, of Vienna, has been elected a foreign member of the Linean Society of London and a corresponding member of the Academy of Sciences at Göttingen.

ON the occasion of his jubilee Lord Lister has been created, by the King of Denmark, a Knight of the Grand Cross of the Order of Dannebrog.

IN accordance with the recommendation of the Paris Academy of Sciences, M. Darboux has been appointed a member of the Bureau of Longitude in the room of the late M. Cornu.

DR. HERMANN NOTHNAGEL, professor of clinical medicine and therapeutics in the University of Vienna, has been nominated a life member of the upper house of the Austrian Parliament.

DR. FREDERICK W. TRUE, executive curator of the National Museum, has been placed in charge of the exhibits of the Smithsonian Institution and National Museum at the St. Louis Exposition.

DR. RUDOLF ADERHOLD has been made director of the Berlin Bureau of Health.

DR. CHARLES J. BELL, professor of chemistry in the University of Minnesota, died on January 4, aged forty-eight years.

THE scientific fraternity, the Sigma Xi Society, has established a chapter at Columbia University.

THE Colorado Institute of Electrical Engineers has been organized at Denver with the following officers: *Chairman,* Henry L. Doherty; *Vice-Chairman,* J. W. Stearns; *Second Vice-Chairman,* A. H. Weber; *Secretary,* Eugene Sayer; *Treasurer,* A. M. Ballou.

UNIVERSITY AND EDUCATIONAL NEWS.

IT is announced that among the New Year's benefactions of Dr. D. K. Pearsons, of Chicago, will be: Illinois College, Jacksonville, Ill., \$50,000; Fargo College, Fargo, N. D., \$50,000; West Virginia Conference Seminary, Buchanan, W. Va., \$50,000; Fairmount College, Wichita, Kas., \$25,000. This would make the total of Mr. Pearsons's contributions to colleges \$4,000,000.

THE Board of Trustees of Hamline University in Minneapolis announces that an endowment of \$250,000 for the university has been raised, principally in Minnesota. Messrs. James J. Hill and M. G. and J. L. Norton, of Winona, gave large sums.

It is announced that the endowment fund for Schurtleff College, at Upper Alton, Ill., has been completed, and that $92,000 has been collected to pay the debt of Albion College, Mich.

The trustees of Union College at Schenectady, N. Y., have received an offer from the General Electric Company to make a gift for the equipment of the electrical laboratory and the annual payment for salaries. The course will be in charge of Dr. C. P. Steinmetz, who will hold the position of professor of electrical engineering.

At a recent meeting of the council of the North Wales University College, Bangor, it was announced that Lady Morgan intended to give to the college a sum of £2,500 to found scholarships in memory of the late Sir G. Osborne Morgan, a former vice-president of the college.

The registration at New York University, which was omitted from the article on the subject by Dr. Rudolph Tombo, Jr., published in the issue of Science for December 26, is as follows:

College of Arts and Pure Science	257	
School of Applied Science	103	
Graduate School	181	
School of Pedagogy	355	
School of Commerce	125	
Summer School	113	
Law School	660	
Woman's Law Class	36	
University Medical College	298	
Veterinary College	55	2183
Deduct names repeated		113
		2070
Teaching Staff		210

The following statements regarding the scientific work of Oxford University are included in a pamphlet issued by the vice-chancellor on the most pressing needs of the university: The keeper of the Ashmolean Museum estimates that not less than £3,500 will be required in the near future for additional cases and upper galleries to meet the rapid increase of the collections. Eventually it will be necessary to erect new exhibition rooms, basement rooms for storage, a coin room and lecture theater; also to add to the library and to provide a librarian. The need of space for extension is also felt by the committee of the picture galleries, and the keeper of the Hope collection of engravings. The want of lecture rooms for the use of the public teachers of the university is dwelt on in several of the replies. The desirability of instituting and maintaining a laboratory for experimental research in the field of psychology is urged by several professors. The urgent needs of the several departments of the University Museum would at the present time involve an additional capital expenditure of £33,000, and an annual expenditure of £3,050 (representing a capital of £100,000); the future needs specified show that a further capital sum of £60,000 and an annual outlay of £4,000 will eventually be necessary. An additional professorship (for which provision is already made by statutes not yet in operation) is asked for applied mechanics. Better endowment is asked for the professorship of human anatomy, the readership in pathology, the Slade professorship of fine art (which it is proposed to make resident and permanent), the Sibthorpian professorship of rural economy (now suspended), the chairs of geology, zoölogy, physics, and experimental philosophy, and the curatorship of the Pitt-Rivers Museum. A large extension of the system of readerships and lectureships is asked for in medicine, natural science, ancient history and archeology. The curators of the schools ask that the electric light may be installed there at a cost of £850.

At a meeting of the senate of the University of London on December 13 it was decided to constitute an additional board of studies in human anatomy and morphology. Dr. Nathaniel H. Alcock was appointed demonstrator in the physiological laboratory till October 1, 1903.

Sir William Muir has resigned the position of principal of the University of Edinburgh. Among those suggested as his successor are Sir William Turner and Sir Archibald Geikie.

Professor Josef Nusbaum has been appointed professor of comparative anatomy at the University of Lemberg.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 16, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*ON THE PHYSICAL CONSTITUTION OF THE PLANET JUPITER.**

THE planet of Jupiter was one of the first objects to which the telescope of Galileo was directed, and the satellites of the planet were among the earliest discoveries made by that instrument. In 1630 the telescope had been constructed with sufficient power to show the great equatorial belt. Previous to the beginning of the eighteenth century the principal phenomena seen on the surface of Jupiter had been observed, and the time of rotation and position of the axis of the planet ascertained. Notwithstanding, however, the great mass of facts which have been collected from observations extending over a period of 200 years, yet up to the present time no theory of the physical condition of the surface has been advanced which has met with universal acceptance. In order that the subject may be more clearly understood it will be well to state briefly the salient features presented to the eye of the observer. The disk of Jupiter appears as an ellipse having axes in the ratio of 14 to 15, the longer axis lying in the direction of the planet's equator. The equatorial diameter is about 89,000 miles.

* Address of the chairman of Section A, Mathematics and Astronomy, and vice-president of the American Association for the Advancement of Science. Read at the Washington meeting, December 29, 1902.

Now as the axis of the planet is nearly perpendicular to the line of sight, we shall see objects in their true dimensions only near the middle of the disk and on the equator. In the revolution of the planet in its orbit, the equator, as seen from the earth, may be displaced 3.3 degrees. Therefore, all objects seen on the disk may apparently be shifted in latitude. At the equator the displacement may amount to 1.1″ of arc, or about one sixteenth of the polar diameter, while in higher latitudes it will be very much less, and at the latitude of 70 degrees the displacement will be only 0.28″ of arc.

During the past twenty-five years some astronomers, who have observed Jupiter for years, imagine that when the planet is turned with its axis three degrees toward the earth, one would be able to see to the pole and beyond. I may say that this is a mistake, for the reason that the displacement of three degrees would amount to only 0.03″ near the pole. It is very rare that any objects are seen beyond 40 degrees of Jovian latitude. The latitude of 70 degrees is only 1″ from the limb, and 80 degrees only 0.25″ from the limb of the planet. Hence objects, if they existed at high latitudes, would be practically invisible. During twenty-three years of observation I have never observed a separate marking beyond 42 degrees of Jovicentric latitude, or 5.7″ of arc from the limb, except on one night when a small white spot was seen in latitude 62 degrees, or within 2″ of the south limb of the planet. Usually a fine shading or discoloration of the disk is seen near the poles. The planet rotates on its axis in a little less than ten hours, and hence the shape and size of an object in passing across the disk will be materially modified by the effect of rotation. An object, when it is first brought into view on the disk by rotation, is infinitely short in length and, as it is brought farther on by rotation, the length is increased, and reaches its maximum when on the central meridian of the disk. In passing off, it of course goes through the same changes in apparent size. As the meridians on a globe are curved lines, objects in passing across the disk may apparently be displaced in longitude in regard to each other, due to the curvature of the meridian, viz., two spots lying in different latitudes might at one time be on a line parallel to the polar axis of the planet and, when brought on the middle of the disk, would lie in different longitudes. Some astronomers have been misled by phenomena of this kind, considering it to be a real motion of the object, when in fact it is simply displacement due to rotation.

In order then to know what phenomena are real and what are apparent, it is necessary to take into account the position of the earth with regard to Jupiter's equator, as well as the position of the object on the disk of the planet.

Jupiter is distant 5.2 times the distance of the earth from the sun, and at mean distance 1″ of arc amounts to 2,300 miles. Now owing to the great distance of the planet from the earth, the objects we see must have considerable size in order to be visible. I presume that the smallest object which has been observed for longitude or latitude is at least 2,000 miles in diameter. In the case of a line or streak one might be able to see with the aid of the modern telescope 0.1″ of arc in width, which on Jupiter would be 230 miles, but all the markings which have been observed are considerably greater in size than this minimum value. The ordinary spots we see on Jupiter, from which rotation time has been determined, have usually been upward of 3,000 miles in diameter, where the spot is circular or elliptical.

I began systematic observations on Jupiter in the year 1879, and these have been continued every year with the exception of the opposition of 1888 and a part of

1889, when the telescope was dismounted. I may say that, previous to this period, the observations of phenomena have usually been made by estimation. This was true with regard to the determination of longitude almost without exception, and very few positions in latitude have ever been determined with the micrometer. Amateur observers, who have no driving clock or micrometer, must necessarily rely on eye estimates for longitude and latitude, but when a telescope is equipped for micrometer work there is no better excuse for guessing than in the determination of the distance of a pair of double stars.

Sketches or drawings of the planet Jupiter are of very little value in the absence of other data. It is not unusual to find the latitude of conspicuous markings eight or ten degrees in error, and longitude a corresponding amount. At the beginning of my observations on Jupiter I decided to fix the size and position of all objects seen on the disk by micrometrical measurement. By such a system of procedure positive facts will be established, which in time may enable us correctly to interpret the complicated phenomena observed.

During the past twenty-five years the so-called canals and double canals on Mars have been the subject of much discussion. I believe if their position were fixed by micrometrical measurements, we should soon be able to decide what is real and what is imaginary.

In order to use the micrometer for measurements on a planet, it is necessary to know the size of the disk. Jupiter has been measured by many astronomers, both with the micrometer and with the heliometer, but the measurements made differ considerably, due to two causes. First, irradiation, which depends on the size of the telescope, or rather on the magnifying power employed. Second, the increased size of the image, due to the condition of the atmosphere. In the use of the heliometer the true irradiation may be eliminated, but not the increased size of the disk due to definition. In any case the measured size of the disk depends directly on the magnifying power employed.

In 1880 I made a series of measures of the polar and equatorial diameter of the planet with powers of 390 and 638, and in 1897 a series of measurements with powers of 390 and 925. In all cases, whatever the condition of the seeing, the lower power gave the larger diameter. From the measures made on six nights in 1897, when the seeing was good enough to be able to use a power of 925, the difference for the two powers employed was: polar, $+0.27''$; equatorial, $+0.31''$. In 1880 for ordinary seeing the difference for the two powers employed amounted to $1''$. In order, therefore, to have some standard of size it would be necessary to decide upon the magnifying power employed with which the measures were made. Because of this apparent change in the size of the disk due to definition, to locate with precision any object on the surface of the disk, or a satellite off the disk, it is necessary to refer the object to both limbs of the planet at the time of observation. If the object is referred to only one limb, under unfavorable atmospheric conditions an error of $1''$ of arc would be easily possible, but if it is referred to both limbs, then the effect of the irradiation, or enlargement of the disk, is almost wholly eliminated. In the reduction of my micrometrical work on Jupiter I have used the values $18.33''$ and $19.48''$ for the semi-axes of the planet at mean distance.

These values for the size of the disk were found from a great many differential measures made in 1880–1 with a power of 390, and are somewhat larger than those given by the heliometer, owing to

irradiation, but they will probably better satisfy micrometer work.

The observations for longitude, latitude and magnitude of objects on the planet Jupiter have all been made with the parallel-wire micrometer, preferably near the central meridian, but no rigid rule is followed in this respect. The longitude and latitude are usually determined whenever the spot or marking is wholly on the disk and distinctly visible.

The longitudes are measured by ascertaining the distance of the apparent center of the object from the limb of the planet, according to the method I pointed out some years ago. A determination of longitude or latitude generally consists of three bisections of the object and each limb of the planet. In the case of longitude, one half of the difference of the distances at the mean of the times is the distance of the apparent center of the object from the central meridian on the visible disk. This method of determining longitudes has been found to be greatly superior, in point of accuracy, to the method of transits, as well as a great saving of time.

The error in measurement of objects on a luminous disk is about twice as great as that from the measurement of double stars of equal distance. The ordinary error for location of objects in latitude or longitude on the disk of Jupiter may be placed at about 0.25″ arc.

Twenty-five years ago it was almost the general opinion among astronomers that the phenomena seen on the planet Jupiter were transitory in their nature; that there was no permanency in the spots and markings, but that the aspect of the planet changed from day to day, and even at less intervals of time. Perhaps we shall get a better idea of what was known about the subject by quoting from Grant's 'History of Physical Astronomy':

"Although generally there appear only three belts upon the disk of the planet, sometimes a greater variety is perceptible. Sometimes only one belt is visible. This is always the principal belt situated on the northern side of the planet's equator. On the other hand, its whole surface has occasionally been seen covered with belts. On the 18th of January, 1790, Sir William Herschel, having observed the planet with his forty-foot reflector, perceived two very dark belts dividing an equatorial zone of a yellowish color, and on each side of them were dark and bright bands alternating and continuous almost to the poles. A similar appearance was once noticed by Messier. These phenomena sometimes undergo very rapid transformations, affording thereby a strong proof that they owe their origin to the fluctuating movements of an elastic fluid enveloping the body of the planet. On the 13th of December, 1690, Cassini perceived five belts on the planet, two in the northern hemisphere and three in the southern hemisphere. An hour afterwards there appeared only two belts nearer the center and a feeble trace of the northern belt. The same astronomer frequently witnessed the formation of new belts on the planet in the course of one or two hours. The dark spots on the disk of the planet also afforded unequivocal indications of the existence of an atmosphere, for it is impossible to reconcile their variable velocity with the supposition of their being permanent spots adhering to the surface of the planet. Cassini found from his observations that the spots near the equator of the planet revolved with greater velocity than those more distant from it. Sir William Herschel found that the velocity sometimes underwent a sensible change in the course of a few days. He supposed the spots to be large congeries of cloud suspended in the atmosphere of the planet, and he ascribes

their movements to the prevalence of winds on its surface which blow periodically in the same direction.''

Lardner, in his 'Astronomy,' says: 'In a month or two the whole aspect of the disk may be changed.'

In my annual report to the Chicago Astronomical Society for the year 1881, I stated that the phenomenon seen on the surface of Jupiter was of a more permanent character than had hitherto been believed to be the case.

In 1878 a large and conspicuous object known as the Great Red Spot was seen on the disk of Jupiter. It appears that this object was first noted on June 2, by Lohse, of Potsdam, but in looking up previous records, we find a spot seen in the same locality by the ancient astronomers. In the years 1664–6, a great red spot was observed by Hook and Cassini. It was situated one third of the semi-diameter of the planet south of the equator in latitude 6″. Its diameter was about one tenth the diameter of Jupiter, or about 8,000 miles. This spot appeared and vanished eight times between the years 1665 and 1708. From 1708 to 1713 it was invisible; the longest time of its continuing to be visible was three years, and the longest period of its disappearing was five years. Since its appearance in 1878 it has been visible with large telescopes during the whole period, but at times so faint that, except for the indentation in the equatorial belt, the spot, perhaps, would have been lost to astronomers, as it was formerly when they had smaller instruments.

The great red spot is 11.61″ or 37.2 degrees in length, and 3.87″ in breadth, or about 27,000 miles long, 9,000 miles broad, elliptical in outline, and, if we suppose the depth of the spot equal to its width, its volume would be about three times that of the earth. This object, which seems to have great permanency, is not stationary in either longitude or latitude.

It was visible in 1869 and 1870, when it was observed by Gledhill on four nights from November 14 to January 25, and on one night by Mayer. The data for ascertaining the rotation period have been derived from the drawings made, and necessarily are approximate.

The rotation period was $9^h\ 55^m\ 25.8^s$, or about eight seconds less than it was in 1879. From the observations made in 1878 I derived a rotation period of $9^h\ 55^m\ 33.7^s$. Since the rotation period had been increasing for twenty years, the observations in 1869 are of value in tracing the motions of this object.

I may add that Mr. W. F. Denning, who has compiled the observations of what is presumed to be the red spots from 1831 to 1899, finds a rotation period of $9^h\ 55^m\ 34^s$ between 1869 and 1878, by assuming the number of rotations between consecutive observations. But where the interval is five years and upwards this is a very unsafe method of procedure, as will be perceived from the motions which have been studied during the last twenty-three years.

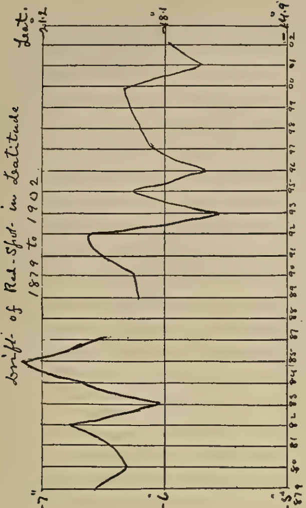
From the measures which I have made every year I have determined the rotation period for the red spot from 1879 up to the present time, and with the minimum value in 1879 of $9^h\ 55^m\ 34^s$. The diagram shows the rotation period at any point between 1879 and the present time. The vertical lines are intervals of 400 days, one day more than the synodic period of the planet. The horizontal lines represent seconds of arc, so that the rotation period at any point will be shown on the curve, the seconds being at the left hand of the diagram, and the time at the bottom of the diagram. The rotations for this curve were computed for intervals of 400 days by using at each epoch about twelve normal places, and the

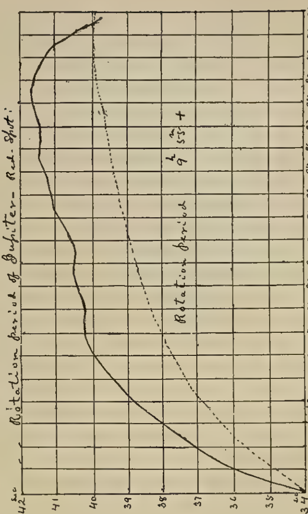
probable error on the rotation period, as determined in this way, varies between ± 0.02 sec. and ± 0.07 sec. The curve is perfectly smooth for the first six years, showing that the motion of the spot was very regular. Since that period the curve is not absolutely smooth, which may be due to the faintness of the object, and the shifting of the center from which the measurements were made, when the measures were referred to the bay in the equatorial belt. My measures, when the spot was very indistinct, have been referred to the center of the bay, and that may account for the small irregularities in the curve during the later years. From the diagram it is seen that the rotation period of the planet reached its maximum between 1898 and 1899, being 41.7 seconds. Previous to 1898 the spot had an apparent retrograde motion on the disk of the planet, and since that time the spot apparently has come to rest, and now has a direct drift around the planet. The rotation period for the last 400-day interval is 39.75 seconds, but the actual period at the present time is about three seconds less than it was in 1898. From the inspection of this curve, taken in connection with the rotation period which I found for 1870, it would seem to require a long cycle to make the rotation period the same as it was in 1879. The dotted curve indicates the 'mean' rotation period at any instant, counting from September 25, 1879. The 'mean' period for the interval 1879 to 1902 is $9^h\,55^m\,39.93^s$.

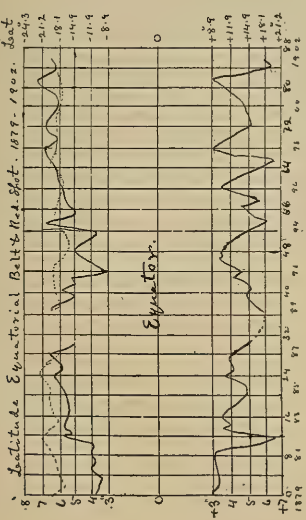
In 1880, when the red spot was most conspicuous, it was seen, when brought on the disk by rotation, at 87 degrees of longitude, or $2^h\,35^m$ in time from the central meridian, when its length was only second of arc. When the spot is wholly on the disk its longitude is 71.4 degrees and the apparent length 3.7″. It is possible that the rotation period may be connected with its visibility, viz., when the spot comes back to the same rotation period it had in 1879 it may become more conspicuous and reddish in color. This object has drifted in longitude about three and one fourth times around the planet since 1879, assuming the rotation period at that time to be the true rotation period of the planet. It seems to me, however, more probable that the time of rotation of the planet is longer than any period hitherto determined, in which case all objects would drift in the same direction. The object also has a motion in latitude, and the total displacement in twenty-three years has been 1.7″, or about 4,000 miles drift in latitude. The rate of drift in longitude and the visibility may possibly be due to the greater or less submergence of the spot in the material which composes the surface of the planet.

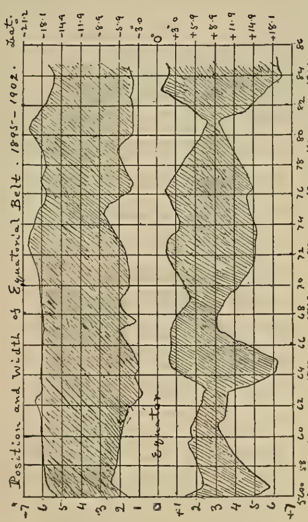
The diagram shows the mean latitude of the red spot at each opposition corrected for the elevation of the earth above Jupiter's equator. It seems that during these twenty-three years the spot has approached nearly 1″ nearer the equator than it was in 1879. The short time scale, the vertical lines being intervals of 400 days, makes the displacement appear more abrupt than it really is. The Jovicentric latitude is given on the right hand of the diagram. At the present time this is about eighteen degrees. We might add that this displacement in latitude of the red spot is very much less than the displacement of the great equatorial belt.

The most conspicuous marking on the surface of the planet is the great equatorial belt, which is always visible. This belt may appear as one belt, but usually is composed of two portions lying on either side of the equator of the planet. In 1880 it was practically one belt extending without break for a short time across the surface of the equator. From the study of the


Drift of Red-Spot in Latitude
1879 to 1902


Rotation period of Jupiter-Red-Spot.
Rotation Period


Latitude Equatorial Belt & Red-Spot. 1879-1902.
Equator.


Position and Width of Equatorial Belt. 1895-1902.
Equator

changes in this belt one may arrive at some idea regarding motions taking place on the surface of the planet. The systematic determination of motion in latitude has never been undertaken by any one previous to the observations which I began in 1879. Occasionally latitudes have been measured during one opposition. Arago, in 'Astronomé Populaire,' raised the question whether the belts on Jupiter are fixed in size and position, and he gives some measures of the positions from 1811 to 1837, and takes the mean of these various measures for getting the mean position of the belts on the planet. These observations are approximate, and are used without regard to the position of the earth above and below Jupiter's equator. From 1879 to the present time the latitude and width of the great equatorial belt have been measured on nearly every observing night, so that we may ascertain the position of the edge of the belt at any instant. It is found that the north edge of the belt has had a drift in latitude of nearly 4″ of arc or 12 degrees, and the south edge about the same amount. The changes in the drift of the belt are usually slow and gradual, but it is possible sometimes that considerable change may be observed in the course of a few days. The diagram indicates the position of the edge of the belt from 1879 to 1902, and it is of very great interest in showing at a glance the changes that have taken place in latitude. From the study of this diagram it appears that the disturbances take place on both edges of the belt at practically the same time. The matter composing the belts generally has a motion on both sides of the equator in opposite directions.

In 1879 the whole width of the belt was about 7″ of arc. In 1882 it widened out and has at times reached a width of about 13″ of arc. The edges of the belt remain practically parallel to the equator in all longitudes. I have noticed two marked exceptions. On October 3, 1882, there was a curved projection in longitude plus 30 minutes, following the great red spot. On October 14 the edge was smooth at the same longitude and the whole belt had drifted so far north as to coalesce with B_3. Also on February 24, 1897, in longitude plus five hours, the preceding half of the north edge of the belt drifted about two seconds farther north than the following portion. On February 27, however, the edge of the belt was comparatively smooth in the same longitude.

Aside from the drift of the edges of the belt in latitude, the belt itself changes dimensions from time to time to a considerable extent, and these changes have been studied from micrometrical measurements since 1895. The diagram shows the width of the two portions of the equatorial belt at any instant from 1895 to 1902. The diagram indicates the width and not the shape of the belt at any time. Now it is seen, taking the portion of the belt north of the equator, at times it becomes very narrow; for instance in 1896 it was about 1″ arc in width, 1897 it was about 5″ in width, and then it became narrower again in 1898, and continued wide from that time until 1901, when it was less than 1″ arc in width and appeared as a faint line on the planet. The south portion of the belt has not passed through so great change during the five years, and has been more steady in latitude and width. On either side of the equator are fainter belts which usually extend to 40 degrees of latitude as separate belts. These faint belts are subject to change, in both size and position, from year to year.

On the belts and on the surface of the planet there are frequently seen small

spots, sometimes white and sometimes black, viz., 2,000 miles or more in diameter, and from the observations of these spots we have determined the rotation period of the planet for different parts of the surface. The spots, which appear near the north margin of the equatorial belt nearly every opposition and are sometimes permanent for two or three years, and have a slight motion in latitude, only a fraction of 1″ of arc, whereas the belt may move 3″ or more in latitude in one year. It seems to me that this fact has an important bearing as to location of the objects, viz., the belt and the spots. I infer from the slight displacement of the spots that they lie at a lower level in the Jovian surface than the equatorial belt, and for the same reason the great red spot lies at a lower level.

The transits of the satellites of Jupiter offer phenomena which have a direct bearing on the constitution of the planet. The satellites at times cross all parts of the disk in transit. For a normal transit the satellite disappears at some distance from the disk after ingress and reappears at a similar distance before egress. From this fact it is concluded that the center of the disk of Jupiter has the same reflecting power as the satellites. With the $18\frac{1}{2}''$ refractor I have ascertained that a satellite can be followed for a distance of 10″ of arc from the limb or nearly one quarter the diameter of the disk before it disappears in transit. However, when the transit occurs within 10″ of the north or south limbs, the satellite can be seen during the entire transit across the disk. Now since the satellite is not supposed to be hot enough to give light, we conclude there is not sufficient heat in the planet to produce light. The observation of the eclipse of the satellite also shows that it has no inherent light of its own.

Aside from the period of $9^h\ 55^m$, some spots and markings give a shorter period of $9^h\ 50^m$, indicating that these objects have a motion of about 250 miles an hour in the direction of the planet's rotation, assuming that the true rotation period is $9^h\ 55^m$. For mechanical reasons the spots which give this shorter period must necessarily be located above the spots which give the longer period of $9^h\ 55^m$. From 1879 to 1885 two white spots in latitude 6 degrees south were observed every year, giving a rotation period of $9^h\ 50^m$ plus. The white spots, during the last twenty years, which give this short period, have been observed between the latitudes plus 11 and minus 8, and also in one year, in 1891, black spots which gave a short period were observed in latitude 20 degrees north. The spots and markings which give the long period of $9^h\ 55^m$ have been observed in latitudes between 37 degrees north and 38 degrees south and within 12 degrees of the equator.

The equatorial belt sometimes approaches the equator very closely, and its rotation for some years has been the same as that of the great red spot, for the spot and the belt have, as we know, maintained the same position toward each other. Hence we find the longer rotation period of $9^h\ 55^m$ in precisely the same latitude as the shorter period. On examining the table of rotations there does not seem to be any connection between latitude and rotation period, as has often been alleged. The longest period which I observed, covering an interval of 156 days, is $9^h\ 56^m\ 0.4^s$, which was in latitude 26 degrees north.

Mr. A. S. Williams has written some articles on the rotation of the surface of Jupiter in which he finds zones of constant currents. These speculations are not sound, for the reason that in the same latitude we find different rotation periods for the same instant of time, and, as I have said before,

there is no law connecting rotation period with the latitude, except we find this period of 9^h 50^m more commonly between the limits of -8 and $+11$ degrees, whereas the longer period is distributed indiscriminately over the surface of the whole planet as far as 38 degrees latitude.

The question has sometimes been raised as to whether the phenomena on Jupiter were periodic. The inclination of Jupiter's equator to its orbit being only three degrees, any periodicity due to the revolution of Jupiter around the sun should recur at intervals of about twelve years, but from the motions which I have shown for the displacement of the belts in latitude there does not seem to be any regularity in the period. I presume any periodicity is of the same nature as we have in the meteorology of the earth. We have, of course, a sequence in the seasons and a sequence in weather conditions, but our sequence in weather conditions does not follow any regularity, and if changes on Jupiter are due to meteorological causes, we should not expect to find any definite period.

The application of photography to astronomical observations has been of great value in various directions, but up to the present time it has been of no benefit in the study of planetary details. Photographs of the planet Jupiter have been made since 1880 at different times, but they only show the simple outline and some of the conspicuous markings. The scale of photograph is so small that it cannot be used with any degree of success for determining position on the disk. There is no question, however, that if we are ever able, by increasing the sensitiveness of our plate, to make an enlarged photograph of Jupiter or Mars such as is seen through the telescope with the eye, it would be a great advance, and it would enable us to decide very many questions, which are now impossible owing to the limited time that we are able to study the object under consideration, due to the rapid motion of the planet on its axis. The phenomena seen on the planet depend in a great measure on the size of the telescope and the magnifying power employed. In my work on Jupiter I have habitually used a power of 390, which is adapted to most conditions for seeing and will show minute detail. With the same telescope, using a power of 190, the appearance of the disk is quite different, and minute detail cannot be seen with distinctness. The observers who have small telescopes of five or six inches in aperture and use a comparatively low power do not see the phenomena as they would be shown by larger telescopes and high power. Hence in any question of disagreement, observation with the small telescope should have very little weight. The principle is precisely the same as in the observation of double stars. While a pair of close or unequal double stars may be easy objects for 18½″ object glass, they are entirely beyond the range of a 6″ object glass.

A misinterpretation of phenomena has given rise to very erroneous notions regarding the changes which take place on the surface of the planet. When we look at the planet Jupiter, we see only about one fifth of the surface in longitude distinctly at any one time, and hence in the course of two hours we should have an entirely new set of features under view of the eye of the observer. The faint belts north and south of the equator sometimes only extend over a portion of the circumference of the planet, and in such case one might see a greater or less number of belts after the interval of two hours or more, as has been stated by Cassini and others.

My observations during the past twenty-

three years have established the following facts:

1. The equatorial belt changes in both size and position to a considerable extent, but these changes are usually slow and gradual. Occasionally, however, a marked change may be observed in the features of the belt in the course of a number of days.

2. The fainter belts also are displaced in latitude and in the amount of material of which they are composed. The visibility of the fainter markings and spots depends in a considerable measure on the distance of the planet from the earth. When the planet is at more than mean distance, the so-called polar belts are very faint and sometimes invisible, even with a large telescope, and are not brought into view until the planet approaches toward opposition. This fact I noticed particularly in the early years of my observation on Jupiter, when the observations were made as near the sun as possible.

3. The egg-shaped white spots, which appear in this form from perspective, as they are probably nearly circular, are found both north and south of the equator and are very permanent in latitude. They are usually from one to two seconds of arc in diameter. These spots are not fixed with regard to each other, even when they are located in the same latitude.

4. Aside from the white spots, there are dark spots of similar size, sometimes on the faint belts and sometimes entirely disconnected from the belt. The dark matter is not as stable as the egg-shaped white spots, and probably lies at the same level as the equatorial belt.

5. Near the equator are found white spots, usually of a larger size and more irregular in shape, which give rise to the period of 9^h 50^m.

The mean density of the planet Jupiter is 1.37 times that of water. The spheroidal figure of the planet indicates that the density increases as we proceed from the surface to the center. In the case of the earth the density at the surface is about one third the mean density, and assuming the same rule for Jupiter, its surface density would be 0.4 to 0.5 that of water. The liquefaction of air and gases during recent years enables us to imagine a medium which would have the density corresponding to that of the surface of the planet. The older astronomers, of course, had no knowledge of any substance between atmosphere and liquid, and hence, in forming their theories of the motions on the surface of the planet, the theory was necessarily atmospheric, but there is now no excuse for maintaining an atmospheric theory which will not account for the phenomena observed.

A probable theory of the constitution of the planet should in some degree satisfy all the phenomena observed. No one can draw legitimate conclusions from casual observations. On the surface of Jupiter we find the following objects: (1) The great red spot, which is the most stable of all objects seen on the disk of the planet. During the period that its size has been measured with the micrometer one cannot say with certainty that there has been any change in its size or shape from 1879 to 1902. It is now conceded by astronomers that the object is identical with the spot observed by early astronomers. Such being the case, it would seem to be absurd to say that anything in the nature of a cloud should persist in the same form for more than 200 years. Its spheroidal shape in connection with its stability would seem to show that it has volume and mass. Its motion in latitude, as we have already seen, is much less than for the equatorial belt. The matter of which it is composed is in a different condition to that of the belt. In 1880 I had the good fortune to notice the transit of a satel-

lite over the red spot. The satellite, which was invisible during transit, when projected on the spot appeared as bright as when off the disk. On the contrary, when satellites transit the belt they are invisible. (2) Egg-shaped white spots from 2,000 to 5,000 miles in diameter. These spots I have found in north latitude 13 to 37 degrees and in south latitude from 18 to 27 degrees. These objects do not look like clouds, and so far as we know they do not change their shape during the six months while under observation. They are also very stable in latitude and give a rotation period of $9^h\ 55^m +$. (3) Small black spots seen on the belts or entirely separate. These objects give a rotation period of $9^h\ 55^m +$, but on one occasion in latitude 20 degrees north I found a short period. (4) The dark matter forming the system of belts including the equatorial belt and the so-called polar belts, which also give a rotation period of $9^h\ 55^m$. (5) The white spots which give a rotation period of $9^h\ 50^m$.

It seems to be the opinion of most writers on Jovian phenomena that the planet is yet at a high temperature, but not self-luminous. The high temperature is favorable for the explanation of some of the phenomena observed. I have long held the opinion that a simple atmospheric theory was not sufficient. The greater luminosity of the center of the disk indicates absorption of light, probably due to an extensive atmosphere. The white spots which give a rotation period of $9^h\ 50^m$ are of different form and size from the egg-shaped spots which give the period of $9^h\ 55^m +$. The short period spots are greater in size and irregular in shape, sometimes appearing simply as a rift in the equatorial belt. Having these facts before us, we can formulate a theory which will fairly well satisfy all classes of phenomena.

I assume that the visible boundary of Jupiter has a density of about one half that of water. This medium is in the nature of a liquid; in it are located the great red spot and the egg-shaped white spots. In such a medium all motions in longitude and latitude would be slow and gradual, and the shape and size of the object would have great permanency. The equatorial belt and the so-called polar belts may be located on the surface or at a higher level than the red spot. In the middle latitude within twenty degrees of the equator the higher atmosphere carries a layer of dark matter in the direction of the rotation of the planet at a velocity of about 250 miles per hour, making a complete circuit around the planet in 44 days. In this envelope are formed the openings which we call white spots and, by unequal distribution, black spots. The great bay in the south edge of the equatorial belt may be accounted for by assuming that the great red spot is at a lower temperature than the medium in which it floats, and by its lower temperature condensing a portion of the vapor composing the belt. In 1882, when the edge of the belt drifted south, it did not come in contact with the spot at any point, although it advanced at times beyond the center. In 1883 I stated that the spot seemed to have a repelling influence on the belt. During the past twenty years, when the belt and the spot were in proximity a depression was formed in the belt directly opposite, which was of the same form as the contour of the spot. The belts may be assumed to be some sort of vapor of considerable density. The cloudlike matter, which in the equatorial regions is moving over the surface at the rate of 250 miles per hour would account for the minor changes on the surface of the equatorial belt. I think the theory I have given offers a more plausible explanation of the various phenomena observed than the off-

hand statement that we see simply clouds floating in the atmosphere of the planet.

G. W. HOUGH.

THE ORIGIN OF TERRESTRIAL PLANTS.*

I SHOULD like to invite your attention for a little while to some of the factors that apparently have been operative in determining the changes which plant structures have undergone in the course of the development of the vegetable kingdom. While some of these are perfectly obvious, others are by no means so evident, and, as might be expected, there is not perfect agreement among botanists as to the relative importance of some of these factors, nor indeed of their efficiency at all.

I shall not attempt here to go into any extended discussion of the remarkable results obtained by Professor De Vries in his recent studies upon variation in plants. These are too important, however, to be dismissed without some mention. The conclusion reached by Professor De Vries is that, in addition to the variation within the limits of species, there may be sudden variations, or 'mutations,' which, so to speak, overstep the limits of the species, and thus inaugurate new species. While the results obtained, especially in the case of *Œnothera Lamarckiana*, are certainly most striking, more data are necessary before we can accept without reserve the conclusions reached. It is certain that marked changes—'sports,' as the gardeners term them—often appear without any explainable cause, and it is equally difficult to understand, what for want of a better term, we can only term 'tendencies' to develop in special directions. Thus the specialization of the sexual reproductive cells, which has evidently taken place quite independently in several unrelated lines; the development of heterospory, and probably of the seed-habit in different groups independently, are hard to explain without assuming an innate tendency to vary in a determined direction.

It is not, however, with these exceedingly difficult and often obscure problems that we shall concern ourselves here, but rather with those changes in plant structures which are referable to more or less evident response to known conditions.

Speaking in broad terms, I think we can reduce the determining factors to three categories, leaving aside the inherent tendencies to variation. These three sets of factors are: (1) those relating to the food supply, (2) the relation to water and (3) those concerned with reproduction.

It is hardly necessary to say that there is no fundamental distinction between plants and animals. At the bottom of the scale of organic life are many forms, especially those belonging to the group of Flagellata, which are intermediate between the strictly animal and vegetable organisms.

We may safely assume that the primitive organisms were motile, perhaps resembling some of the existing flagellates. Of the latter some are destitute of pigment and approach the lower Protozoa; others are provided with chromatophores containing chlorophyll and resemble the lower plants. It is highly probable that the forms with chromatophores are able to assimilate carbon dioxide, as the typical plants do, and may be denominated 'holophytic.' The forms without chlorophyll are probably, like animals, dependent upon organic food for their existence.

If we compare the holophytic flagellates with those forms which have no chlorophyll, a significant difference may be noted, which is evidently associated with

* Address of the chairman of Section G, Botany, and vice-president of the American Association for the Advancement of Science. Read at the Washington meeting, December 29, 1902.

their nutrition. The holophytic forms are noticeably less motile than the others. Thus *Euglena,* one of the commonest green flagellates, becomes encysted before division takes place. The resting cell has a firm membrane about it, and closely resembles a typical plant cell. The forms without chromatophores, however, *e. g., Scytomonas,* may divide longitudinally in the active condition. This difference in motility between the forms with and without chromatophores seems to be the first hint of the differentiation of the characteristically motile animals and immobile plants.

One group of plants (Volvocaceæ) evidently allied to the Flagellata, and sometimes even included with them, like animals, show active locomotion during their vegetative existence. Aside from these, and the Peridineæ, which may be remotely related to them, locomotion is exhibited only by such reproductive cells as zoospores and spermatozoids. The frequent reversion to the motile condition found in the reproductive cells suggests the probability that these have been derived from similar ancestral forms.

The loss of motility in typical vegetable cells is associated with the formation of a firm membrane, usually of cellulose, about the cell. This precludes all movement of the cell, except in those cases where openings are present, through which extensions of the protoplasm, usually in the form of cilia, protrude.

The power of free locomotion was probably a character of the primitive vegetable cell, but with the development of the holophytic habit, this power has been lost by the vegetative cell of most plants. The loss of locomotion in plants may probably be connected with the development of the power to assimilate carbon dioxide, the main source of food. As the CO_2 in the air, or dissolved in water, is constantly being received, it is not necessary for the plant to move from one place to another in search of food, and we find plants becoming more and more stable. Where animals are so placed that their food supply is abundantly received, they may assume an immobile plant-like habit. This is especially marked in many marine animals, such as corals, hydroids, sponges, ascidians and such molluscs as oysters. The old name 'zoophyte' applied to corals and similar animals was not in all respects a misnomer. These rooted marine animals exhibit another resemblance to plants in the development of free swimming larvæ, analogous to the active zoospores produced by so many algæ. In both instances it is safe to assume that the motile stage is older than the fixed condition.

Lack of time forbids our consideration in detail of the very important, but by no means clearly understood, problems dealing with the evolution of sex in the vegetable kingdom. Thus the reason why the development of distinct sexual cells has taken place in an almost identical manner in several widely separated groups of plants is hard to explain. The sexual cells, or gametes, have beyond question been derived from non-sexual ones. Thus in several groups of algæ; *e. g.,* Volvocaceæ, Confervoideæ and Phæophyceæ, there still exists an almost perfect series of forms leading from the non-sexual zoospores to perfectly differentiated male and female gametes. The formation of sexual or non-sexual reproductive elements is, in many cases at least, largely dependent upon the conditions under which the plants are grown. This has been very clearly shown by the remarkable series of investigations made by Professor Klebs upon various thallophytes. For a discussion of the meaning of sex, the reader may refer to the recent papers on the subject by Strasburger and Beveri.

In short, while we know to a considerable extent some of the factors which determine the formation of sexual cells, where these have already been developed, the reasons why sex has developed are still very obscure.

Secondary reproductive structures, such as sporangia, seeds, flowers, fruit, etc., are readily enough explicable and need not be dwelt upon here.

PHOTOSYNTHESIS.

Perhaps the most important physiological property of green plants is the photosynthesis, or the ability to utilize the energy of the sun's rays for the manufacture of the primary carbon compounds necessary to build up living protoplasm. That some of the most striking modifications of the plant body are directly associated with photosynthesis is certain. The development of leaves in various groups of plants is, perhaps, the most obvious response to the needs for photosynthesis. The leaf is, *par excellence,* the photosynthetic organ. The spreading out of the green cells so as to offer the most favorable exposure to the light rays, and in the higher plants the development of stomata and the spongy mesophyll, or special assimilating tissues, are especially perfect. Leaves are by no means confined to the vascular plants, however. We need only recall the simple leaves of mosses and liverworts and the similar organs in the more highly organized seaweeds, such as *Sargassum* or *Macrocystis.* Even among the truly green algæ simple photosynthetic organs may be developed. The dense branching tufts of *Draparnaldia* or the expanded frond of *Ulva,* for example, are of this nature.

The leaves of these lower plants are very different morphologically from those of the ferns and seed plants, but show very clearly that they are physiologically of the same nature; *i. e.,* they are *analogous* but not *homologous.*

Other special modifications associated with photosynthesis are the peculiar lacunar tissues found in the thallus of the Marchantiales and in the sporogonium of the true mosses and in *Anthoceros.* In all these instances there are formed, in connection with the green lacunar tissue, more or less perfect stomata. These upon the apophysis of the sporogonium of many mosses, and over the whole surface in *Anthoceros,* are precisely similar to those found upon the leaves and other green organs of the vascular plants.

While it is usually stated that, among the bryophytes, appendicular organs are quite absent from the sporophyte, the apophysis, or special assimilative organ at the base of the capsule in some of the more specialized mosses like *Polytrichum* and *Splachnum,* might almost be so regarded. In the latter genus it sometimes forms a broad disk several times the diameter of the rest of the capsule, and is just as truly a special organ for photosynthesis as is the leaf of a fern or flowering plant.

WATER.

Even more important than the changes of the plant body associated with photosynthesis are those which are due to the plant's relation to the water supply. All organisms require a certain amount of water in order that the protoplasm may perform its functions. Protoplasm is not necessarily killed by the withdrawal of water, but it is rendered inactive, as may be readily seen in such structures as seeds, spores, etc.

The lowest organisms, whether plant or animal, are virtually aquatic; for, although they do not necessarily always remain in a liquid medium, they become quiescent when moisture is withheld. Very many, like most algæ, are true aquatics, and it

is safe to assume that the progenitors of the higher plants lived in the water. The nearest approach to these ancestral forms which have survived are probably certain green algæ, which have retained much of their primitive simplicity. Much the greater number of living plants, however, have given up the primitive aquatic habit for life on land. In adapting themselves to this new habitat they have contrived to exist with a much diminished water supply, which has enabled them to outstrip the much simpler forms which have retained their old aquatic habit.

The change from the primitive aquatic condition to the much more varied conditions of terrestrial existence is bound up with profound changes in the organization of the plant body.

MARINE PLANTS.

Of the existing plants which have retained the primitive aquatic habit, the most important are the various types of marine algæ, including not only the larger seaweeds, but also the minute pelagic forms like the diatoms and Peridineæ. Many of the larger seaweeds are very much better developed than the simple green freshwater algæ, and show many special modifications associated with their peculiar environment. Not being subject to the drying up which threatens all fresh-water organisms at times, it is very rarely that marine algæ develop any form of resting-spores such as are so common among freshwater algæ. On the other hand, those which grow between tide-marks, where they are regularly exposed at low-tide, develop mucilaginous or gelatinous tissues, which prevent too complete loss of water. This is especially well seen in the large kelps and similar forms. Some of these, also, reach an enormous size, and develop leaves which are often provided with bladder-like floats, which bring them to the surface when they are exposed to the light.

Very characteristic are the minute pelagic plants, especially the diatoms and Peridineæ, which are important constituents of the plankton, or surface life of the sea. These floating plants are generally provided with some sort of buoyant apparatus, evidently an adaptation to their pelagic life. Small as these floating algæ are individually, they are immensely important to ocean life, as they constitute the main source of food for the hosts of animals inhabiting the sea.

The great subkingdom of fungi offers many interesting problems bearing upon the evolution of plant-forms, but there is no reason to suppose that any higher types of plants have ever arisen from the fungi, many of which are doubtless plants of comparatively recent origin. Most of their peculiarities are associated with their nutrition, which is entirely different from that of typical plants. Not having chlorophyll, they are, like animals, dependent upon other organisms for food. Consequently all fungi are either saprophytes, living upon dead organic matter, or as parasites they attack living animals and plants.

I can not dwell here upon the extremely difficult problems connected with the origin and affinities of the fungi, even if I felt competent to discuss them.

THE ORIGIN OF TERRESTRIAL PLANTS.

We have now to consider what causes led to the abandonment of the aquatic habit by the algæ ancestors of the vascular plants, and how this radical change in their environment has influenced the development of the structures of the higher plants.

Nearly all fresh-water plants are exposed to destruction at times, by the drying up of the bodies of water in which

they live, conditions which are never met with in the life of most marine organisms. This necessitates some means of surviving the periods of drought, and has resulted in the development of various devices for carrying the plants through from one growing period to another. While a few low aquatics, like *Pleurococcus* or *Oscillatoria*, may become completely dried up without being killed, in most fresh-water algæ there are produced special cells—spores—which are more resistant than the vegetative cells and survive the death of the rest of the plant body. These resting spores may be produced non-sexually, as in *Nostoc*, or the 'aplanospores' of some of the green algæ; but more commonly they are the product of the union of sexual cells, or gametes, and may be generally denominated 'zygotes.'

This condition of things of course precludes growth, except when an abundant water supply is provided. It is evident that any device by which the vegetative life of the plant can be prolonged is an obvious advantage.

Some such contrivances, of a simpler kind, are seen in some of the lower green plants. Thus the gelatinous mass in which the filaments of a *Nostoc* colony are imbedded, or the 'palmella-stage' of some Confervoideæ, offer a certain amount of resistance to the loss of water, and serve to prolong the period of vegetation. Less commonly root-like organs are developed which enable the alga to live on the wet sand, penetrating into it and drawing up water from below. Species of *Vaucheria* and *Botrydium* exhibit this very well.

We may imagine that some algal form, perhaps related to the existing Confervoideæ, adopted a similar amphibious habit, developing rhizoids, by means of which it could vegetate in the mud after the subsidence of the water in which it was growing, in a manner analogous to that exhibited by certain amphibious liverworts still existing. The well-known *Ricciocarpus natans*, for example, lives first as a floating aquatic, but may later settle in the mud, as the water subsides, and there vegetates much more luxuriantly than in its aquatic condition.

The change from a dense medium like water to the much rarer atmosphere necessitates the development of mechanical tissues, to give the plant the requisite support in the air. There must also be developed devices for protecting the tissues against excessive loss of water due to transpiration. Other modifications are to insure economy of water in fertilization.

In submerged aquatic plants water is absorbed directly by all the superficial cells, and of course there is no loss due to transpiration. Moreover, special conducting tissues are made less important, and are either quite wanting, as in most algæ, or much less developed than in related terrestrial forms. As soon as a plant becomes terrestrial there must be provided organs (roots or their equivalent) for drawing up from the earth water to replace what is lost by transpiration, and in all but the simplest forms special conducting tissues to facilitate its transport. In the lower types of land plants, the absorptive organs are usually simple hairs (rhizoids), but these are quite inadequate to supply a plant of large size, and consequently it is only those terrestrial plants which are provided with a true root system that have succeeded in reaching a large size. Even in the lower terrestrial forms the rhizoids do not monopolize the absorption of water, but many of them are able to absorb water directly through the leaves or through the superficial cells of the thallus. While this is especially marked in many mosses and liverworts, which are, so to speak, more or less aquatic in their behavior toward water, it is by no means

confined to them, as most vascular plants develop structures, seeds, tubers, bulbs, etc., which can absorb water directly. Less commonly the leaves of vascular plants have this property. This is especially marked in various xerophilous plants, such as the Californian gold-back fern (*Gymnogramme triangularis*), *Selaginella rupestris* and other species, many species of *Tillandsia*, etc.

As all botanists know, the structural differences between aquatic and terrestrial plants are very marked, but there are some transitional forms which illustrate very beautifully the change from one to the other, and the efforts of the plant to adjust itself to the changed conditions. Thus some plants which are usually strictly aquatic, such as some water-lilies, may assume a nearly terrestrial condition, the long-stalked, floating leaves being replaced by those borne upon shorter upright petioles.

The primitive aquatic plants are either unicellular or simple cellular plants with relatively little differentiation of parts, as might be expected in organisms living in a relatively uniform medium. A necessity for their active existence is an abundant water supply, as they are not provided with any adequate means for resisting desiccation, although the mucilaginous or gelatinous substances in which their cells are sometimes imbedded serve to retard for a short time the loss of water by evaporation when they are exposed to the air. A good many of the lower fresh-water organisms are capable of becoming dried up without losing their vitality, but of course their activity is stopped. More commonly they depend upon special resting cells, or spores, to carry them through periods of drought or cold.

In exceptional cases, the lower algæ may assume an amphibious habit, living upon wet mud instead of actually in the water. *Botrydium* and some species of *Vaucheria* develop a simple root system by which the loss of water by transpiration is made good so long as the soil remains moist; but these quickly die as soon as the mud dries, as their cells are not protected against loss of water by evaporation.

It is, however, among the bryophytes, or mosses, that anything approaching a satisfactory solution of the problem of a terrestrial existence is attained. (I am leaving out of account the fungi.) All of the mosses are, to a certain extent, amphibious, since all of them require first water in order that fertilization may be effected. A small number, *e. g.*, *Riccia fluitans*, *Riella*, *Fontinalis*, etc., are genuine aquatics, and the life history of such a form as *Ricciocarpus natans* illustrates what has probably been the origin of the terrestrial habit in the primitive archegoniates. *Ricciocarpus* is usually a floating plant, but it not infrequently assumes a terrestrial habit, sometimes preliminary to developing its reproductive organs. This is brought about by the subsidence of the water until the plant is left stranded on the sand. Under such circumstances it grows very vigorously, develops numerous rhizoids which penetrate the mud and supply it with water. Excessive loss of water is checked by the development of a cuticularized epidermis covering the exposed surface of the thallus. It is highly probable that in some such way as this the algæ ancestors of the first archegoniate plants began their life on land, and slowly emancipated themselves from the necessity of being surrounded by water, and of course thus became more and more independent of the drying up of shallow bodies of water in which they grew. In this way the vegetative period would be much prolonged, and would give the plant a great advantage

over its aquatic competitors, and thus the terrestrial habit was established.

Some liverworts and mosses may reach considerable size, a foot or more in length in a few cases. They also exhibit a certain amount of specialization, corresponding to the requirements of the terrestrial environment. Well-developed leaves are present in nearly all true mosses, and in many liverworts, and in one order of the latter, the Marchantiales, the plant body, while retaining its thallose character, develops a complicated assimilative tissue, with stomata of a peculiar type not found elsewhere. In the upright forms mechanical tissues are developed, and in the true mosses there is present in the leafy shoots a central strand of conducting tissue, comparable to the vascular bundles found in the sporophytes of the vascular plants. Indeed the analogies existing between the leafy moss-shoot and the sporophytic shoots of the vascular plants are sufficiently obvious.

No existing bryophytes have succeeded in reaching any but the most modest dimensions. All the larger forms either are prostrate or grow in dense tufts, offering mutual support to the leafy shoots. Indeed no moss seems to have quite solved the problem of a self-supporting upright leaf-supporting axis. Neither have they successfully solved the problem of an adequate water supply, to compensate for loss of water by transpiration, and this of course is closely associated with the limit of size which the plant-body could assume. Given an unlimited water supply, and a plant, even of low organization, may attain very large dimensions, as we see in the giant kelps. Those plants, although in many respects of very low rank, nevertheless may reach hundreds of feet in length, and develop specialized tissues, curiously suggesting those of the highly organized land plants. These giant seaweeds absorb water throughout their whole superficial area, and there is no loss of water by transpiration; but for a terrestrial plant to reach a large size there must be adequate means for absorbing water from the soil, and for transporting it expeditiously through the plant to those places where water is being lost through transpiration.

In the highest terrestrial plants, the 'vascular' plants, we meet first with a perfect system of water-conducting tissue. This is the woody portion of the fibro-vascular bundles, composed of the characteristic tracheary tissue, first encountered in the ferns, and common to all the higher plants.

ORIGIN OF THE SPOROPHYTE.

Among the lower terrestrial plants, the Archegoniatæ, which comprise the mosses and ferns, a very marked characteristic is the 'alternation of generations.' By this is meant that in its development the plant passes through two very different phases, a sexual and a non-sexual one. This is perhaps best seen in the ferns. The spore of the fern, on germination, gives rise not to the leafy fern plant, but to a much simpler plant much like a small liverwort, upon which the sexual reproductive organs, the archegonium and antheridium, are borne. This sexual plant is known as the gametophyte. Within the archegonium is borne the egg-cell or ovum, which, after being fertilized, ultimately produces the leafy fern plant, or 'sporophyte,' from its producing the spores, or non-sexual reproductive bodies.

Among the lower Archegoniates, the gametophyte is relatively much more important, and the sporophyte is never an independent plant, as it is in the ferns, but always remains to a greater or less extent dependent upon the gametophyte for its existence.

An alternation of generations is hinted at among some of the green algæ, but never becomes sharply defined as it is in the archegoniates. Among the red algæ, however, it becomes clearly marked, and also in many fungi. In both of the latter cases it is extremely probable that we have to do merely with analogies, as there is not the slightest evidence of any genetic connection between either of these groups and the archegoniates.

With the green algæ, however, the case is somewhat different, and it is highly probable that the earliest archegoniates arose from some forms not very different from *Coleochæte,* a green alga in which the fertilized egg gives rise to a very simple sporophytic structure.

The increase in the output of the zygote, or fertilized egg, due to its division into a number of spores, instead of forming at once a single new individual, is an evident advantage which becomes increasingly important as the gametophyte assumes the character of a terrestrial plant, and the chances of fertilization, which requires the presence of water, become correspondingly lessened.

There are two theories as to the origin of the alternation of generations among the archegoniates, the 'homologous' and 'antithetic.' The first holds that the non-sexual sporophyte is a direct modification of the gametophyte and probably arose from it as a vegetative outgrowth. The antithetic theory holds that the sporophyte always, in normal cases, arises from the fertilized ovum, and is a further development of the zygote which has arisen in response to the requirements of a terrestrial existence. There is not time here to consider at length the relative merits of these two theories. In a special paper before the section, I hope to bring this matter up for discussion. For present purposes I shall assume that the latter (antithetic) view is the correct one.

As the ancestors of the archegoniates left their original aquatic habitat, the question of the water supply became of the first importance. All of these lower land plants have retained many of their original characteristics, among them the development of motile male cells (spermatozoids), which require free water in order that they may reach the egg-cell and fertilize it. That is, the plants are, to a certain extent, amphibious, and must return to the water in order that fertilization may be effected. It is very clear, then, that anything which tends to increase the number of spores resulting from the developed zygote will be advantageous, rendering a single fertilization more and more effective.

The alternation of sexual and non-sexual plants among the green algæ is not sharply marked, and has been shown to be largely a matter of nutrition. Nevertheless, as already mentioned, there is a hint of an alternation of generations in certain forms like the higher Confervoideæ. In these the germinating zygote produces a larger or smaller number of zoospores, which give rise to as many new individuals. From some such form as these in all probability the primitive archegoniates arose. As these became distinctly land plants, the motile zoospores resulting from the zygote of the algæ gave place to the non-motile spores characteristic of the terrestrial archegoniates; but of any transitional forms we are quite ignorant, and the gap between algæ and archegoniates is a very deep one.

The gradual specialization exhibited by the existing liverworts and mosses is familiar to all botanists, and will only be briefly discussed here. Enough to say that from the simplest type, a globular mass of spores, with almost no sterile tissue developed, such as occurs in the Ricciaceæ, there are

still found almost all intermediate conditions, culminating in the large and complex sporangia of the true mosses, and the somewhat similar but much simpler one of *Anthoceros*.

In following such a series it is clear that spore-production, the sole function of the primitive sporophyte, becomes largely subordinated to the purely vegetative existence of the sporophyte. Thus in such a moss as *Polytrichum*, the sporogenous tissue does not appear until a late period in the development of the sporophyte, and comprises but a very small fraction of its bulk. An elaborate system of assimilative tissue, with lacunar green tissue and stomata like those of the vascular plants, is developed, and the loss of water due to transpiration is made good by a strand of conducting tissue, which represents a simple type of vascular bundle.

While the elaborate sporophyte of the mosses offers certain suggestions of the structures of the vascular plants, it is much too highly specialized in other directions to make it in the least probable that it has given rise to any higher forms. The equally dependent but much simpler sporophyte of the peculiar group of the Anthocerotales is probably very much more like the forms from which this independent sporophyte of the ferns arose than is the more highly developed sporogonium of the true mosses.

The subject of the gradual elaboration of the sporophyte cannot be dismissed without reference to the very important work of Professor Bower, whose clear exposition of the progressive sterilization of the tissues of the originally exclusively sporogenous sporophyte is one of the most important contributions to the subject.

When we review the extraordinarily large number of resemblances between both gametophyte and sporophyte in the ferns and liverworts, the weight of evidence, to my mind, is overwhelmingly in favor of assuming a real genetic connection between the two groups. To say 'that no structures among plants seem to have left so little trace of its origin as do the leafy sporophytes of Pteridophytes and Spermatophytes,' is certainly to ignore all the principles of comparative morphology. When we reflect that the reproductive organs and mode of fertilization are the same in all archegoniates; that the early divisions and growth of the embryo are identical; that in the more specialized bryophyte the sporophyte develops assimilative and conductive tissues strictly comparable to those of the Pteridophytes; and finally, that the spore formation is identical to the minutest details; surely such a statement is very far indeed from stating the truth.

The fallacy of the arguments based upon apogamy has been ably refuted by Professor Bower. He has called attention to the fact that nearly all cases of apogamy are abnormal, and occur in forms where the sporophyte normally is produced from the egg. It is also noteworthy that the greater number of cases of apogamy occur in extremely variable species, such as the crested varieties of different ferns (*e. g.*, *Scolopendrium vulgare* var. *ramulosissimum*). Professor Bower has also called attention to the fact that these are all forms belonging to the highly specialized and relatively modern group of Leptosporangiatæ. If apogamy is a reversion to a primitive condition, it is strange that it should occur in the least primitive ferns rather than in the older types.

I think we may fairly class the phenomena of apospory and apogamy with the numerous cases of adventitious growths so common among both pteridophytes and seed plants. In these the whole sporophyte may originate as a bud from any

part of the plant. Such adventitious shoots may arise from leaves, as in many ferns, *Begonia, Bryophyllum,* etc.; from roots, in *Ophioglossum,* and many seed plants, *e. g., Populus, Robinia, Anemone,* etc., or even from sporangia, as in the budding of the nucellus of the ovule recorded in several cases of polyembryony. Now, no morphologist would argue from these that they are in any sense reversions, and I can not see why the case of apogamous, or aposporous budding is essentially different.

No bryophytes have quite emancipated themselves from the aquatic habit of their algal progenitors. While they may often dry up for an indefinite period without being killed, there is, nevertheless, much of the same dependence upon an ample water supply that we find in the algæ. Although much more resistant to loss of water through transpiration than are the few terrestrial algæ, nevertheless the bryophytes, as a rule, are much less suited to a genuine terrestrial habit than are the vascular plants. Much the same means are employed by many bryophytes in the absorption of water as by the algæ. Water may be absorbed by all the superficial cells, the roots playing a minor rôle as absorbents, except in those forms in which the plant is a prostrate thallus, where roots are often developed in great numbers. These delicate rhizoids, however, would be quite inadequate to supply the needs of a leafy stem of any but the most modest proportions. In a few bryophytes, *e. g., Chimacium,* there are rhizome-like modifications of the shoot, which may to a limited degree be compared to roots, but any proper roots, like those of the vascular plants, are quite absent. It would seem as if nature's attempts to adapt the originally strictly aquatic gametophyte to a radically different environment had been only partially successful, owing to the failure to develop an adequate root system to restore the water lost through transpiration. It may be that the range of variation any structural type may undergo is limited.

If we accept this hypothesis, it may help to explain the significance of the alternation of generations as developed among the archegoniates, and we can understand why the sporophyte has gradually replaced the gametophyte as the predominant phase of the plant's existence. Attention has already been directed to the perfectly well-known fact that sudden marked variations may appear in plants without any apparent cause. The work of De Vries emphasizes this, and refers all radical advances in structures to such mutations, which are clearly distinguished from the variations which occur within the limits of a species, but which can not apparently overstep certain limits.

In accordance with this view it is quite conceivable that the first appearance of the leaf upon the sporophyte may have been comparatively sudden—that is, there may not necessarily have been a long series of preliminary structures leading up to a true leaf.

It has been urged that the antithetic theory of the nature of the sporophyte involves the sudden appearance of a new structure. The fallacy of this claim has been pointed out by Professor Bower, and a little thought will show that no claim is made of the sudden appearance of a new structure. While no strictly intermediate forms are known, there is certainly no difficulty in seeing the essential homology between the rudimentary sporophyte of such an alga as *Coleochæte* and that of *Riccia.* The antithetic theory merely claims that the structure developed from the zygote, which at first is devoted exclusively to spore formation, gradually develops vege-

tative tissue as well, and finally attains the status of an independent plant.

The highly organized sporophyte of the higher archegoniates is connected with the lower types by an almost continuous series of existing forms, and through these with the still simpler structures found in the green algæ. The increased output of spores, with a corresponding number of new plants resulting from a single fertilization, is an obvious advantage, and undoubtedly is the explanation of the origin of the sporophyte.

If we compare the sporophyte of even the simplest liverwort with that of the algæ, there is noted an essential difference. The spores, instead of being motile zoospores, are non-motile, thick-walled structures, adapted to resist drying up—in short, the sporophyte is a structure essentially fitted for an aerial existence. Except in the very lowest types, there is developed a special massive absorbent organ, the foot, which is not unlike the root developed in the higher types, and is very different from the delicate rhizoids of the gametophyte. The latter always shows, to a greater or less degree, its aquatic origin.

From the time that the sporophyte has attained the dignity of an independent existence, its development proceeded on lines very different from those followed by the essentially aquatic gametophyte. As we have seen, the efforts of the latter to assume a terrestrial habit have met with only partial success, and it would appear that nature concluded to try again, taking as a starting point the essentially terrestrial sporophyte, which, as a functionally new development, seems to have proved more plastic than the gametophyte.

From the first, and this I believe to be highly significant, its water supply was obtained indirectly through the medium of a special organ, the foot. It is not important for a consideration of the question whether the foot in all forms is or is not homologous—enough that we find for the first time an organ sufficiently massive to supply all the water needed by the tissues of the developing sporophyte. The foot is a very different organ from the delicate rhizoids of the gametophyte, and much more like the true roots of the vascular plants, which, it is highly probable, arose as further modifications of the foot of the sporogonium of some bryophyte.

With the massive root penetrating the earth and thus establishing communications with the water supply, the sporophyte becomes entirely independent. The possession of an apical meristem in the root allows of unlimited growth, and gradually the massive root system of the higher plants has been evolved, keeping pace with the increase in size of the sporophyte, which, except with rare exceptions, obtains its whole water supply through the roots. Correlated with this increase in size of the sporophyte has been developed the characteristic conducting tissues which constitute the vascular bundles. While rudimentary vascular bundles are found in the sporophyte of many mosses and in *Anthoceros*, the characteristic tracheary tissue, *par excellence* the water-conducting tissue of the vascular plants, occurs only among the latter forms.

With the establishment of the sporophyte as an independent plant, the gametophyte serves mainly to develop the sexual reproductive organs from which the sporophyte arises. While the gametophyte among the lower pteridophytes is a relatively large and independent green plant, sometimes living for several years, it becomes much reduced in size among the more specialized heterosporous types, and may live but a few hours, as in species of *Marsilia*. In such forms little or no chlorophyll is developed by the gametophyte, which depends for its growth upon

the materials stored up in the spore, or even lives parasitically upon the sporophyte, as in *Selaginella*, thus reversing the relation of sporophyte and gametophyte found in the lower archegoniates.

All of these modifications are in the direction of economy of water, in accord with the needs of a more and more pronounced terrestrial habit.

Just as heterospory arose independently in several groups of pteridophytes, so also the seed habit—the final triumph of the terrestrial sporophyte over the primitive aquatic conditions—developed more than once. The female gametophyte, included within the embryo-sac, develops without the presence of free water, and the germinating pollen-spore also absorbs the water it needs from the tissues of the pistil, through which the tube grows very much as a parasitic fungus would do. Except in a very few cases, the male cells of the seed plants have lost the cilia, the last trace of their aquatic origin, and are conveyed passively to the egg-cell by the growth of the pollen-tube.

Once firmly established as terrestrial organisms, and the problem of water supply solved, the further development of the seed plants is too familiar to need any special comment here. The great importance of water in affecting the structure of land plants is seen in the innumerable water-saving devices developed in the so-called 'xerophilous' plants, seen in its most extreme phase in such desert plants as cacti, or in the numerous epiphytes, like many orchids and bromeliads.

In short, it is safe, I think, to assert that of all the extrinsic factors which have affected the structure of the plant body, the relation to the water supply holds the first place. The most momentous event in the development of the vegetable kingdom was the change from the primitive aquatic habit to the life on land which characterizes the predominant plants of the present.

Douglas Houghton Campbell.

SECTION A, MATHEMATICS AND ASTRONOMY.

Vice-President—Professor George Bruce Halsted, Austin.

Secretary—Professor Charles S. Howe, Cleveland.

Member of Council—Professor John M. Van Vleck.

Sectional Committee—Professor G. W. Hough, Vice-President, 1902; Professor E. S. Crawley, Secretary, 1902; Professor G. B. Halsted, Vice-President, 1903; Professor C. S. Howe, Secretary, 1903; Professor Ormond Stone, five years; Professor J. R. Eastman, four years; Dr. John A. Brashear, three years; Professor Wooster W. Beman, two years; Professor Edwin B. Frost, one year.

General Committee—Mr. Otto H. Tittmann.

Papers were read as follows:

Deflections of the Vertical in Porto Rico: Otto H. Tittmann, Superintendent U. S. Coast and Geodetic Survey.

Mr. Tittmann gave an account of some large deflections of the plumb line in Porto Rico. Their existence was first noted by Count Canete del Pinar, of the Spanish Hydrographic Commission, which extended a triangulation around the island, but the war or other causes prevented a verification by that commission. The Coast Survey, however, in the course of its surveys extended a triangulation across the island from San Juan to Ponce and proved their existence beyond question. These deflections are so great that they affect the cartographic representation of the island, and a mean latitude had to be adopted, with the result that the northern coast line, as now shown on the maps, had to be moved by half a mile further south and the southern coast line by the same amount further north than would have been the case if the astronomical latitude had been used.

Saint Loup's Linkage: Professor L. G. WELD, University of Iowa.

The linkage described by M. Saint Loup in the *Comptes Rendus* for 1874 was discussed with reference to its application to the solution of cubic equations. An instrument constructed upon the principle in question was exhibited and operated. The failure of the device to give the numerically greatest root, or the single real root, was pointed out and explained. Attention was also directed to the fact that this root corresponds to a conjugate point of the locus traced by the linkage and can not, therefore, be reached by continuous motion in the plane of reals.

A Device to Prevent Personal Equation in Transit Observations: Professor S. P. LANGLEY, Secretary of the Smithsonian Institution.

Read by title.

The Solar Constant and Related Problems: S. P. LANGLEY, Secretary of the Smithsonian Institution.

Our absolute dependence on the light and warmth received from the sun makes the study of solar radiations of the highest utilitarian value, even apart from their scientific interest. So little is even now certainly known about the actual amount of the solar radiation, and the absorption of it which the solar gaseous envelope and the earth's atmosphere together cause, that it is doubtful if any one can predict just what influence a given change in the total radiation of the sun would produce on earthly warmth and life.

Early work of the author at Allegheny and upon Mt. Whitney relating to these studies was referred to, however, as showing certain limits within which important predictions could be made, and then attention was drawn to the present investigations of the Smithsonian Astrophysical Observatory. The great improvements in instrumental equipment within recent years were pointed out. Charts were exhibited illustrating how the total radiation expressed in terms of each wave-length as it reaches the earth was accurately represented, by means of an observation lasting only a few minutes, where formerly over two years' labor were required to do still less. Other charts showed how these amounts were corrected, step by step, until the rate of the sun's radiation on the outside of the earth's atmosphere (commonly known as the solar constant) is determined.

The absorbing action of water vapor in the air was shown by a chart of results extending from March to November. It was stated that a yearly cycle of these absorption effects is recognized.

Attention was especially called to the probably great utilitarian importance of variations of absorption in the solar envelope, in their effect upon all life, and to the consequent utility as well as scientific interest of the work now being renewed here to determine this with hitherto unknown fullness.

Good Seeing: S. P. LANGLEY, Secretary of the Smithsonian Institution.

Astronomers have at all times been hindered in all delicate observing by the disturbances arising in our own atmosphere, even in clear weather. The ill effect of these disturbances on the telescopic image is known commonly as 'boiling' (as contrasted with 'good seeing'), and it is the great enemy to accurate observation. Within recent years, therefore, there has been a movement to establish observatories in the most favorable localities to avoid this difficulty, regardless of all considerations of convenience. The author who has made a special study of the subject on mountain tops and elsewhere, has been led to think that the major part of the disturbance arises in the air comparatively

near the observer. He has accordingly attempted so to act on this nearer body of air as to prevent what may be assumed to be the main cause of the 'boiling.'

To do this, it has hitherto been sought by astronomers to keep the air in the telescope tube as still as possible. What may be assumed to be novel in the writer's plan is to vigorously churn this air by means of blowers, or in other ways. The still air is known to produce a disturbed image. That the air agitated under this new plan paradoxically produces a still image, has been shown by photographs (exhibited) of the images of artificial double stars whose beams were entirely confined within a horizontal tube in which they traveled to and fro through 140 feet of 'churned' air. These photographs showed that the disturbance within the tube itself appears to be wholly eliminated by the device of vigorously stirring the air column.

In continuation of the experiments, a tube was pointed up toward the sky, and so moved as to roughly follow the sun and thus form an inclined addition to the telescope tube itself. Within this tube the air was similarly churned. Very considerable improvement of the solar image resulted from the whole combination, but owing to the condition of the sun, the weather and the apparatus, the work has not yet reached a stage where it can be shown that improvement was due to the extension toward the sun, distinctly from the agitation in the tube.

The merit of churning the air within the telescope tube itself is believed to be demonstrated by these photographs, which show the results of this artificial 'good seeing.'

The Foundations of Mathematics: Dr. Paul Carus, Editor Open Court Publishing Co., Chicago.

Having briefly sketched the history of metageometry from Euclid to the present day, he declared that the problem was not mathematical but philosophical. At the bottom of the difficulty there lurks the old problem of the *a priori*. Kant wrongly identified the ideal with the subjective, and thus he regarded the *a priori* as a conception which the mind by its intuitive constitution transfers upon the object. The *a priori,* however, is purely formal, and the purely formal is an abstraction from which everything particular, viz., the sensory, is omitted. It can best be characterized as 'anyness'; it is a construction that would suit any condition, hence universality is implied and universality involves necessity.

There are two kinds of *a priori,* the *a priori* of being, which is pure reason, and the *a priori* of doing, a construction that is the result of pure motion. Our metageometricians tried to derive the basic geometrical principles from pure reason but failed. The truth is that other systems of geometry are possible, yet after all, these other systems are not spaces, but other methods of space measurements. There is one space only, although we may conceive of many different manifolds, which are contrivances or ideal constitutions, invented for the purpose of determining space.

The speaker developed space by motion in all directions after the analogy of the spread of light, and characterized the straight line as the path of greatest intensity corresponding to the ray.

Clifford derives the plane by grinding down three bodies until the three surfaces are congruent. The main feature of the plane is that it is congruent *with itself.* It can be flopped, and in either case it divides space into congruent halves. If we halve the plane, which can be done by folding a piece of paper, we have in the crease a representation of the straight

line; and if we double the folded paper upon itself (another method of halving it), we have the right angle. The three planes at right angles are the simplest systems of a combination of these products of halving.

The speaker concluded that Euclidean geometry is a construction *a priori* of both pure being and pure doing, that other geometries are possible, but that no other is so practical as the one which utilizes the straight line, the plane, and the right angle, viz., the boundaries that are congruent with themselves. Further explanation of his views may be expected in articles to be published in the coming year.

Evidences of Structure in the Mass of the Sun: Professor FRANK H. BIGELOW, U. S. Weather Bureau.

This paper discussed the distribution in longitude and latitude of the output of solar energy as shown by the relative frequency of the prominences, spots and faculæ. The observations used were those made in Italy by Secchi, Tacchini and Ricco during the years 1872 to 1900, and as they form a very regular series, the annual variations are comparable and indicate real changes in the transmission of energy from the interior of the sun to the outside. The result is to show that in longitude there is a maximum of spots, faculæ and probably prominences on two opposite sides of the sun, as if there exists in one axial direction an excess of impulse over that at right angles to it. The same distribution on one diameter has been detected already in the terrestrial magnetic field and in the meteorological elements. In latitude it is shown clearly that, on recovering from a quiescent state at minimum output, the new outpouring of energy takes place in middle latitudes, 25° to 50°, and during the increase spreads in two crests, one towards the equator and one towards the poles, the former dying away near the equator and the latter in about latitude 60°. The connection that probably exists between this phenomenon and the Helmholtz-Emden distribution of heat curves in the interior of the sun indicates a very important type of circulation which may prove to be characteristic of the sun. Incidentally, the paper discussed the rotation period in different latitudes, and the application of the periodgram to such a problem.

Spectrographic Proof of the Rotations of the Planets Jupiter, Saturn and Venus: PERCIVAL LOWELL, Director, Lowell Observatory.

Read by title.

The Teaching of Geometry: Professor GEORGE BRUCE HALSTED, Austin, Texas.

Of late, very remarkable discoveries have been made in geometry, affecting its very foundations. These discoveries have a noteworthy application to the teaching of geometry. Some of these discoveries and applications are considered in abstract as follows: (1) The time has come for advance, (2) need for a preliminary course, (3) the preliminary must fit the rational geometry, (4) rigor gives simplicity, (5) Euclid's unannounced assumptions, (6) the betweenness assumptions, (7) superposition, (8) congruence and symmetry, (9) the real beginnings, (10) the definition of straight as shortest, (11) double import of problems, (12) use of figures, (13) graphics, (14) necessity for non-Euclidean geometry, and (15) adaptation to teaching.

Special Periodic Solutions of the Problem of n Bodies: Professor E. O. LOVETT, Princeton University.

This note constructs analytically the particular solutions of Lehmann-Filhés in the problem of n bodies analogous to those of Lagrange in the classic three-body problem.

The method of Poincaré is then used to design other periodic solutions; by an easy reduction the equations become amenable to the treatment proposed by Oppenheim in the corresponding case of three bodies.

The Problems of Three or More Bodies with Prescribed Orbits: Professor E. O. Lovett, Princeton University.

This paper has points of contact with and generalizes certain theorems due to Bertrand, Darboux, Halphen and Oppenheim. Two problems are studied:

1. The determination of the curves which three bodies may describe under central forces possessing a force function, this function to have a form assigned in advance. The results, other than those which are well known, are transcendental.

2. The determination of forces which maintain the motions of any number of bodies in prescribed orbits independent of initial conditions in a space of any number of dimensions, the forces assumed central. It appears that in general a certain number of the forces may be chosen arbitrarily. In ordinary three-dimensional space this indetermination can not be made to disappear; the solution not becoming determinate until the case of those bodies in the plane is reached.

Note on the Secular Perturbations of the Planets: Professor Asaph Hall, Professor of Mathematics, U. S. Navy (retired).

It is known that the determination of the secular perturbations of the principal planets of our solar system depends on the solution of an equation of the eighth degree. The roots of this equation depend on the masses of the planets; and if the masses are changed the values of the roots will change also. In this paper an example is given of the changes in the roots, from one set of masses to another, by means of the formulas computed by Stockwell. The results indicate that the formulas of Stockwell can be used with advantage, and that the labor of solving the equation of the eighth degree can be much diminished.

The Bolyai Centenary: Professor G. B. Halsted, Professor of Mathematics, University of Texas.

On the fifteenth of December, 1902, is the centenary of the discoverer of non-Euclidean geometry, the Hungarian John Bolyai, or, in Magyar, Bolyai Janos. This extraordinarily important and suggestive subject, non-Euclidean geometry, in its inception, evolution, present state and near future development, was treated in this paper.

The Approach of Comet b 1902 to the Planet Mercury: Charles J. Ling, Manual Training High School, Denver, Colorado.

The questions treated were:

The exact position of comet and planet at time of nearest approach: to obtain accurately distance between the bodies at this time.

The great velocity of comet near perihelion together with the position of orbit takes the comet away from Mercury very rapidly. The effect of Mercury at distance of $2\frac{1}{8}$ millions of miles very slight.

Very questionable, if any, effect will be produced by Mercury which will enable astronomers to tell anything about mass of Mercury.

An Untried Method of Determining the Constant of Refraction: George A. Hill, U. S. Naval Observatory.

This paper called attention to a method of deriving the constant of refraction from transits of pairs of stars in the prime vertical. Remarks were first made upon our present knowledge of the constant as secured from observations of stars at upper

and lower culmination, either by means of the meridian or the vertical circle. A plan was then suggested by which the constant might be secured by proper groups of stars in pairs, observed in the prime vertical.

A Development of the Conic Sections by Kinematic Methods: John T. Quinn, Warren, Pennsylania.

The paper is an abstract of a more general system of kinematic geometry whereby not only the conic sections, but nearly all the higher plane curves are developed by kinematic methods. The following definition will give some idea of its scope:

Kinematic geometry treats of the properties of the areas and curves regarded as functions of the spacial and angular velocities of lines, which move in accordance with some fixed law.

With reference to the conic sections (as those are the curves in which we are at present interested), the originality of their development consists in the introduction of an auxiliary circle, called the directing circle; and the conditions subject to which the intersecting lines are assumed to revolve. The lines are pivoted in an axis and conceived to revolve and move at such rates that certain angles are constantly equal, then the locus of their intersection is a conic section.

That this mode of development makes manifest more than any other the essential unity of the curves, and their dependence upon the same law of generation, is evidenced by the general definition of a conic in this system, referred to a common property.

A conic section is a curve the ratio of the distances of whose points form a fixed point and a directing circle is equal to unity. For the ellipse and parabola, the fixed point (a focus) is in the diameter of the directing circle, for the hyperbola, in the diameter produced.

The problem of constructing tangents to either of the curves from external points in their plane is solved in an extremely simple manner. The mode of procedure is essentially the same for each of the curves. This problem is facilitated by the directing circle, which becomes the directrix of the parabola when the circle becomes infinite.

The point on either of the curves which is common to the tangent through the external point is located by drawing only two lines.

The normal to a curve always is parallel to one of the generating lines. Consequently, as a problem in construction it presents no difficulty whatever.

To construct asymptotes to the hyperbola we have only to describe a circle, upon the line as a diameter, which is limited by the center and the focus. It intersects the directing circle in two points, which, with the center, determine the direction and position of both lines.

Time Determinations at the Washburn Observatory: Professor George C. Comstock, Madison, Wisconsin.

This was a discussion of methods employed in the time service of the Washburn Observatory, with especial reference to the advantages to be obtained by a reversal of the instrument upon each star.

Determination of Time by Reversing on Each Star: Professor Charles S. Howe, Case School of Applied Science, Cleveland, Ohio.

Complete determinations of time were made on several nights by the usual method with clamp west and also with clamp east. On the same nights determinations of time were also made by reversing on each star. The clock errors were compared with those found with the almucantar. A table of azimuths, clamp west and clamp east was given, and it

was shown that the instrument changed greatly in azimuth by reversal.

Note on a Geometrical Analysis: Professor James S. Miller, Emory Virginia.
Read by title.

Concerning Bolzano's Contributions to Assemblage Theory: Dr. C. J. Keyser, Columbia University, New York City.
Read by title.

The Constants of the Equatorial: C. W. Frederick, U. S. Naval Observatory, Washington, D. C.

This paper contained a description of a method for deriving the constants of an equatorial from observations of circumpolar and equatorial stars. The position of the polar axis of the instrument is determined from observations of λ Ursæ Minoris and Polaris near the times of culmination and elongation; also other constants are involved. Collimation and the flexure of the tube are derived from observations of equatorial stars. Very simple formulæ are required in the reduction of these observations.

The effect of the constants in varying the parallel of the micrometer is also considered, and a short process indicated by which micrometer measurements may be corrected for these instrumental disturbances without undue labor.

A Relation between the Mean Speed of Stellar Motion and the Velocity of Wave Propagation in a Universal Gaseous Medium, Bearing upon the Question of the Nature of Ether: Luigi d'Auria, 3810 Locust Street, Philadelphia, Pa.

If the universe were involved in a primordial gaseous medium in equilibrium of temperature, then assuming the density to vary inversely with some power, n, of the distance from the center of this universal gaseous globe, which would be the center of the universe, it is found that $n=2$, or the density varies inversely with the square of distance. If ω and ω_0 denote respectively the density of the medium at any distance z and the mean density of the concentric sphere of radius z, then

$$\omega_0 = 3\omega$$

and

$$\omega = \frac{\bar{u}^2}{6\pi k z^2}$$

in which $\bar{u}$ is the mean square speed of the particles of the medium and K the gravitation constant.

Denoting by σ the density of the medium in the solar system, and by S the distance of this system from the center of the universe, it is found that

$$\sigma = \frac{\bar{u}^2}{6\pi K S^2}.$$

Bodies moving in circular orbits around the center of the universe, at all distances, would all have the same velocity

$$v_0 = 2S\sqrt{\pi k \sigma},$$

and it is found that $\bar{u}^2 = 3/2 v_0^2$; and if V is the speed of wave propagation in the gaseous medium, it is found also that $V^2 = 5/6 v_0^2$. As v_0 must be nearly equal to the mean speed of stellar motion, about 19.3 miles per second according to Kapteyn, it is concluded that the ether can not be a gravitational gas, since this gas could not transmit energy with velocity much greater than 17.6 miles per second. Hence, the ether must be imponderable.

Denoting by R and D the mean radius and the mean density of the earth, and by g the acceleration of gravity, it is shown that

$$\sigma = \tfrac{1}{3}\frac{RD}{g}\left(\frac{v_0}{S}\right)^2,$$

and assuming $S = 159$ light years, an estimated distance of Nova Persei, and as-

suming this star to be near the center of the universe, it would follow that

$$\sigma = 3.9 \times 10^{-19} d$$

in which d is the density of ordinary air. That is, the density of the universal gaseous medium in the solar system would be of the same order of magnitude as the ether. On this basis the density of the medium at a distance of 585,000 miles from the center becomes equal to that of ordinary air, and the concentric sphere of the medium within this radius would have a mass about seven times that of Jupiter, a mass entirely too small to be conspicuous in celestial space.

Condition of Atmosphere, Horizon, and Seeing at the Lowe Observatory, Echo Mountain, California: Professor EDGAR L. LARKIN, Director Lowe Observatory. Read by title.

The officers elected for the next meeting are:

Vice-President—Otto H. Tittmann, Superintendent United States Coast and Geodetic Survey.

Secretary—Professor Laenas G. Weld, University of Iowa.

CHARLES S. HOWE,
Secretary.

SCIENTIFIC BOOKS.

Ueber den derzeitigen Stand der Descendenzlehre in der Zoologie. Von DR. H. E. ZIEGLER, Professor an der Universität Jena. Gustav Fischer. 1902. Pp. 54, with 4 text-figures. M. 1.50.

On the occasion of the seventy-third meeting of the German Naturalists and Physicians in Hamburg, September, 1902, the general question of the present status of the doctrine of organic evolution was presented in three lectures—by a botanist (de Vries), a paleontologist (Koken) and the zoologist, Ziegler. The last lecture is now somewhat extended by notes and appendices and published under the title given above.

It is an interesting account of the present standing of the great *Descendenzlehre* in zoology, given in a temperate spirit; a good lecture for the occasion and the place in which it was delivered.

The subject is considered under four sections: (1) The general theory of organic evolution, (2) natural selection, (3) inheritance theories and (4) the application of evolution to the origin of mankind.

Of these, the first section is treated with a firmer hand, as is justified by the state of our knowledge, and the author reviews interestingly, from the zoological side, some of the evidences in support of evolution. He points out that the general proposition has been so strengthened by the researches of the past forty years that all naturalists agree in accepting it as established. We have no other rational theory of the origin of plants and animals, and, notwithstanding the controversies as to the factors that have brought about the diversity of organic life, the fact of evolution as a process of creation is no longer seriously challenged.

But the compelling arguments in support of evolution do not hold in equal force for natural selection or any other particular theory. Here we have conflicting opinions, but they do not seriously affect the main contention. As Huxley, one of the greatest supporters of natural selection, said: 'If the Darwinian hypothesis were swept away, evolution would still stand where it was,' and the same thing can be said in reference to any theory of evolution that has been offered since.

In regard to natural selection, Ziegler comes to the position of so many working zoologists, that as a factor it is not adequate by itself to afford an explanation of variation and development. In many instances its action is clear—as when variations which are of direct use to the animal are fostered by natural selection, but many other cases like the great development of the backward-directed tusks of the mammoth, and horns of other animals, can not be explained by natural selection.

The third section is more lightly treated. The inheritance theories of de Vries, Nägeli, Haacke and Weismann receive passing men-

tion, but the intricacies of the subject prevented the lecturer from entering into a discussion of them.

In reference to the applicability of evolution to man's origin, the evidences in favor of an affirmative answer have been growing. The discovery, in 1894, of remains of an intermediate type between the higher apes and man—*Pithecanthropus erectus*—bears upon the question. The intermediate character of that form was well brought out by the opinions expressed by competent anatomists, some declaring the remains to be of an ape-like form and others of primeval man.

But more suggestive evidences are found in the comparative study of animal intelligence and of the structure and physiology of the brain. There is a gradual increase in intelligence with increase in complexity of the brain, and the discovery of localized areas presiding over definite coordinated acts brings evidence of the close relation between brain structure and mentality. Clinical studies and criminal anthropology show that disorders of the will and mental derangements are dependent upon disorders of the nervous system. Man can not be separated in his development from other animals; he differs from them in the degree of his development, and his nobility depends, not on his origin, but on how far he is advanced beyond it.

The text of the lecture is followed by six appendices, made up largely of apt quotations which help to show the state of opinion and to illuminate some points of the lecture.

William A. Locy.

Oeuvres Complètes de J.-C. Galissard de Marignac: Hors-série des Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Geneva, Eggimann et Cie.; Paris, Masson et Cie, et al. Vol. I. 4to. Pp. lv + 701.

The collected publication of the scattered writings of a great scientific man forms one of the most adequate and fitting memorials of him, because it enables many otherwise ignorant to perceive the way in which he attained greatness. The present volume, which covers twenty years of the life of the eminent Swiss chemist, is no exception to this rule. It contains, in the first place, an interesting biography by E. Ador, filling the first fifty-five pages, and after this Marignac's papers on atomic weights, crystallography and other chemical and physicochemical subjects, arranged in chronological order, as far as 1860.

These papers form a notable record of unusual ability, enthusiasm and perseverance, of which any nation may well be proud. Only one lack is to be noticed in the present publication, in common with many other French books, namely, the lack of an index. This deficiency may well be supplied in the second installment; for it is to be hoped that this handsome volume will soon be followed by another, completing the record.

Theodore William Richards.

SOCIETIES AND ACADEMIES.

AMERICAN MATHEMATICAL SOCIETY.

During the Christmas holidays the American Mathematical Society held a series of three meetings, at New York, Chicago and San Francisco. The ninth annual meeting of the entire society was held at Columbia University, on Monday and Tuesday, December 29–30. The San Francisco Section held its second regular meeting at the University of California, December 23. The Chicago Section met at the University of Chicago, January 2–3. The meetings were well attended. The several programs included some fifty papers, being about one third of the society's annual production. Ten years ago the United States hardly produced one sixth of this amount of mathematical material. The comparison fairly represents the recent great advances in mathematical interest in this country.

Reports of the sectional meetings will appear separately in Science. The annual meeting, at New York, was attended by sixty members of the society. Twenty-six papers were read at the four sessions. The council announced the election of the following persons to membership in the society: Dr. A. B. Coble, University of Missouri; Mr. W. R. Cornish, State Normal School, Cortland, N.

Y.; Dr. A. G. Hall, University of Michigan; Mr. E. L. Hancock, Purdue University; Professor L. M. Hoskins, Stanford University; Mr. W. D. A. Westfall, Yale University; Mr. W. F. White, State Normal School, New Paltz, N. Y. Sixteen applicants for admission to the society were received.

At the annual election the following officers and members of the council were chosen:

President, Thomas S. Fiske.

Vice-Presidents, W. F. Osgood, Alexander Ziwet.

Secretary, F. N. Cole.

Treasurer, W. S. Dennett.

Librarian, D. E. Smith.

Committee of Publication, F. N. Cole, Alexander Ziwet, D. E. Smith.

Members of the Council, to serve until December, 1905, James Harkness, Heinrich Maschke, Irving Stringham, H. W. Tyler.

The report of the librarian shows that the society's library, which was recently deposited in the charge of the Columbia University Library, is rapidly growing and already contains nearly one thousand bound volumes. The exchange lists of the *Bulletin* and the *Transactions* now include about one hundred and twenty mathematical journals, being nearly all that exist. Many gifts have also been received. It is hoped that the society's collection may ultimately become the most extensive one of the kind in the country. Besides the mathematical journals of the world, it is intended to include a full set of mathematical Americana, thus making the library a historical as well as mathematical repository.

A special feature of the annual meeting this year was the presidential address. Under the title: 'On the Foundations of Mathematics,' the retiring president, Professor Eliakim Hastings Moore, advocated the desirability of the society exercising a more effective influence on the teaching of elementary mathematics. The address will appear in SCIENCE. A committee was appointed by the council to consider the questions involved.

The following papers were read at the annual meeting:

E. V. HUNTINGTON: 'A complete set of postulates for the theory of real number' (second paper).

E. V. HUNTINGTON: 'On the definition of the elementary functions by means of definite integrals.'

C. J. KEYSER: 'On the axiom of infinity.'

G. H. DARWIN: 'The approximate determination of the form of Maclaurin's spheroid.'

HARRIS HANCOCK: 'Remarks on the sufficient conditions in the calculus of variations.'

L. E. DICKSON: 'The abstract group simply isomorphic with the alternating group on six letters.'

PRESIDENT E. H. MOORE: Presidential Address, 'On the foundations of mathematics.'

W. E. TAYLOR: 'On the product of an alternant and a symmetric function.'

E. D. ROE: 'On the coefficients in the product of an alternant and a symmetric function.'

E. D. ROE: 'On the coefficients in the quotient of two alternants (preliminary communication).'

E. O. LOVETT: 'A transformation group of $(2n-1)$ $(n-1)$ parameters, and its rôle in the problem of n bodies.'

I. E. RABINOVITCH: 'On solid lunes of conicoids, analogous to the circular lunes of Hippocrates of Chios.'

E. B. WILSON: 'The synthetic treatment of conics at the present time.'

A. B. COBLE: 'On the invariant theory of the connex (2, 2) of the ternary domain viewed as a connex (1, 1) in a five-dimensional space.'

EDWARD KASNER: 'The general quadratic systems of conics and quadrics.'

W. F. OSGOOD: 'On the transformation of the boundary in the case of conformal mapping.'

W. F. OSGOOD: 'A Jordan curve of positive area.'

MAXIME BÔCHER: 'Singular points of functions which satisfy partial differential equations of the elliptic type.'

J. W. YOUNG: 'On the automorphic functions associated with the group of character $[0, 3; 2, 4, \infty]$' (preliminary report).

R. W. H. T. HUDSON: 'The analytic theory of displacements.'

H. E. HAWKES: 'Enumeration of the non-quaternion number systems.'

H. F. STECKER: 'On the parameters in certain systems of geodesic lines.'

G. D. BIRKHOFF and H. S. VANDIVER: 'General theory of the integral divisors of $a^n - b^n$, and allied cyclotomic forms.'

F. MORLEY: 'On the determinant $|(x_i - a_j)^{-2}|$.'

G. A. Miller: 'A new proof of the generalized Wilson's theorem.'

A pleasant social feature of the meeting was an informal dinner on Monday evening at which about forty persons were present.

The next meeting of the society will be held in New York on Saturday, February 28. Arrangements are being made for the coming summer meeting and colloquium, to be held in August or September.

F. N. Cole,
Secretary.

THE NEW MEXICO ACADEMY OF SCIENCE.

A New Mexico Academy of Science was formed at Las Vegas, N. M., on December 22. The following officers were elected for the ensuing year:

President, Frank Springer.

Vice-President, Dr. Chas. R. Keyes.

Secretary and Treasurer, Dr. W. G. Tight.

Members of Executive Committee, T. D. A. Cockerell, J. D. Tinsley.

The following papers were read:

W. G. Tight: 'The Erosion Cycles of the Rio Grande at Albuquerque.'

E. L. Hewett: 'Notes on the Pecos Indian Tribe.'

H. N. Herrick: 'The Gypsum Deposits of New Mexico.'

J. D. Tinsley: 'The Work of the Department of Soils and Physics of the New Mexico A. and M. College and Experiment Station.'

E. L. Hewett: 'An Archeological Reconnaissance of the Chaco Cañon Region.'

C. E. Magnusson: 'Observations on Soil-moisture in New Mexico from the Hygienic Viewpoint.'

T. D. A. Cockerell: 'Our Present Knowledge of the Fauna and Flora of New Mexico.'

John Weinzirl and C. E. Magnusson: 'Further Contributions to the Study of the Blood Changes Due to Altitude.'

John Weinzirl: 'The Availability of New Mexico's Climate for Outdoor Life.' (Read by title only.)

W. G. Tight: 'The History of the Sandia Mountains.'

T. D. A. Cockerell.

DISCUSSION AND CORRESPONDENCE.

MARINE ANIMALS IN INTERIOR WATERS.

The recent accounts of the finding of squid in Lake Onondaga, New York, recall two similar instances that were brought to the attention of the U. S. Fish Commission several years ago.

The commission received for identification from Northern Michigan a specimen of remora (*Echeneis naucrates*), with the information that it had been caught by an Indian woman in a trout stream on the southern shore of Lake Superior. There was no reason to doubt the facts from the evidence contained in affidavits which were quickly produced. The true inwardness of this matter has never been cleared up, although it was learned that a New York City sportsman had been to this region a short time before and had been in the company of the man who forwarded the specimen.

By a singular coincidence, which must be of interest to psychologists and telepathists, at the time the Indian squaw was catching a remora in a Michigan river a Washington angler was landing another at the Great Falls of the Potomac, 16 miles above Washington and 60 miles from salt water. This specimen was brought to the Fish Commission the next day by the man who caught it, and whose ingenuousness there was no reason to doubt. Later, several of his friends called and explained that they had bought the fish in the market and attached it to his line when his attention was diverted.

On the authority of Professor Hargitt, of Syracuse University, a sargassum fish (*Pterophryne histrio*), said to have been caught in Onondaga Lake, was exhibited in Syracuse some years ago. H. M. Smith.

A BRILLIANT METEOR.

To the Editor of Science: On the evening of November 15, at 6:45 central standard time, a very brilliant meteor was observed in its fall to the earth by many persons in the states of Ohio, Kentucky, Tennessee, Louisiana, Mississippi, Alabama and Georgia. At once, though at first independently of each

other, Professor H. C. Lord, of the Emerson McMillan Observatory, Columbus, Ohio, and the writer began a series of investigations with a view to determining where it should have fallen. We secured reports from some twenty-five or thirty observers scattered over the states mentioned above; none of them, however, were expressed very definitely in terms of angular measurements, excepting those of Professor Lord and myself, and we evidently had not noted the altitude and azimuth of the meteor at exactly the same point of its descent. Satisfied, however, that if any pieces came to the earth, they must have fallen somewhere between Lexington and a point in Elliott County, Ky., where an observer saw the meteor to the west of him, I was induced to hunt down a rumor that it had fallen in Bath County, and was rewarded by finding that it had indeed come to earth in the extreme southern portion of that county, and had been picked up by the man who saw it strike the ground. The exact point struck was a stone in the road in front of the home of Mr. Buford Staten, five miles due south of Salt Lick, Ky.

The stone (for it is an aerolite) is roughly $8\frac{1}{2} \times 6 \times 4$ inches, has a volume of 1,642 c.c., and now weighs, with some pieces chipped off for analysis, 5,725 grms., or about 12 lbs. $10\frac{1}{2}$ oz. It exhibits the usual black crust or varnish, the pittings, the grayish interior, and shows on analysis the disseminated nickeliferous metallic iron.

It is interesting to note that, though the approximate place of this aerolite's fall was not determined by calculations based upon observations giving the azimuths of the point where it appeared to burst as seen from different stations—the meteorite itself having been brought in before our investigations had reached the calculating stage—yet had it not been seen to strike the earth, it is not improbable that it would soon have been found as a result of special search. A projection of the lines of observation in accordance with the azimuths of the Columbus and Lexington determinations (S. 15 degrees W., and N. 81 degrees E.) cross in the southern portion of Bath County, Ky.

Note.—Since writing the above the metorite has been purchased by Mr. Henry Ward for the Ward-Coonley Collection of Meteorites now on deposit in the American Museum of Natural History, New York city.

Arthur M. Miller.
State College of Kentucky.

AN APPLICATION OF THE LAW OF PRIORITY.

The first serious attempt to make regulations for the nomenclature of zoology was by a committee of the British Association for the Advancement of Science in 1842. Since then these rules have been both changed and added to, and may still be modified by the action of future zoological congresses. Nomenclature can never be stable so long as the rules are subject to modification. Why then not apply the law of priority to these rules, and declare that the 1842 rules of the British Association must stand, since they have the priority. Of course there were earlier attempts, just as there were binomials before Linnæus and Darwinism before Darwin, but all acknowledge that the 1842 action was the first serious work on zoological nomenclature. Therefore, following the law of priority, they should not be changed. Additions, of course, should be allowed, and these should also follow the law of priority. This would forever prevent change. The scheme of having a zoological congress to meet at intervals, for the discussion and decision of questions, permits of change; and no one can tell how slight or how great these changes may be in the future. Stability can only be obtained by deciding that something already accomplished can not be changed.

Nathan Banks.

CURRENT NOTES ON PHYSIOGRAPHY.

GLACIAL CHANNELS IN WESTERN NEW YORK.

Fairchild's recent work on the 'Pleistocene Geology of Western New York' ('N. Y. State Museum, 20th Rep. State Geol.,' 1900 (1902), 103–139, plates and maps) includes the most complete statement yet made regarding those remarkable channels worn by rivers that followed temporary courses along the depression enclosed by the spurs of the Allegheny plateau on the south and the face of the retreating

ice sheet on the north. The channels are shown to vary with the character of the rock in which they are cut. The stronger limestones were most worn down where they were cut through to weaker shales, and channels of this kind often have a shallow up-stream floor, separated by a cliff—the site of an ancient waterfall—from a deep gorge with steep walls. Channels cut in shales are often deep all along their length, but their walls are weathered to moderate slopes and their beds are thereby narrowed. Many channels have no northern bank, for the ice that restrained their river on the north has melted away. Some of this kind are to be seen from the N. Y. Central Railroad near Oneida, where the track lies on the ancient river bed. Several small lakes are described as occupying 'plunge-basins' excavated beneath cataracts.

THE SCENERY OF ENGLAND.

'The Scenery of Switzerland,' by Sir John Lubbock, is now followed by 'The Scenery of England' by the same author under his newer title of Lord Avebury (Macmillan, 1902, xxvi + 534 pp., 197 figs. and pl.). The book opens with 85 pages on geology and 30 on general configuration. It then takes up such topics as coast, mountains and hills, rivers and lakes, giving to each a general consideration as well as an account of local examples, and closing with two chapters on law and names as related to topography. Many of the illustrations are half-tone plates, most of which are excellent; one of the incised meanders of the Wye is notably fine. The author disarms the critic in the preface; and indeed it is rather ungrateful to find any fault with a book that must prove useful in many ways; yet there is ground for regret that the plan of treatment adopted was not at once more thorough and more systematic. The treatment of coasts and of rivers, for example, does not do justice to the position of these important subjects in modern physiography. Truly, the items are treated in a rational and explanatory manner, but the arrangement of the items is not such as to impress the reader with their natural relations; the incised meanders of the Wye, for instance, are referred to in the section which describes normal meanders; alluvial fans of mountain torrents are described in connection with the third stage of river development in which the river, 'finally * * * reaches a stage when the inclination becomes so small,' etc. Sea cliffs are described in some detail, but the reader will not learn the relation between the ragged outline and the beachless base of young cliffs, or between the smoother outline and continuous beach of mature cliffs. The attention of geographers and philologists should be called to the new word, 'manywhere' (p. 52), of value intermediate between somewhere and everywhere.

TERMINOLOGY OF MORAINES.

An elaborate historical monograph, 'Geschichte der Moränenkunde,' by Böhm of Vienna (*Abhandl. Geogr. Gesellsch. Wien*, III., 1901, No. 4, 334 pp., 4 pl.) forms an easy means of reference to the writings of various authors on a problem that is equally shared between geologists and geographers. The earliest writers quoted are Münster (1544) and Stumpff (1548). Their successors count up to about 400, and the number of citations is 650; Agassiz, Chamberlin, Heim, Penck and Saussure are the most frequently referred to. This detailed review extends to 217 pages. Then follows a 25-page discussion of the results reached by the Glacier Conference of August, 1899, of which the author was not a member and from whose decision he dissents. The classification and terminology of moraines, as preferred by the author, are next presented in a chapter of 23 pages, closing with a table of 23 kinds of moraines named in six languages. It is notable that drumlin is the only name which holds unchanged in all countries; but moraine itself varies slightly from Italy (morena) to Norway (moræne). In this respect drumlin and moraine are imitated by atoll and monadnock. Those interested in the development of physiographic terminology may perhaps gain a useful hint from these accepted though unintentional contributions towards a universal scientific language; none of the four words are of classic origin; all come from local names of forms that have come to be used as types.

NEW NORWEGIAN MAPS.

SOME of the newer sheets of the Norwegian topographical map, 1:100,000, contain excellent illustrations of cirques, which believers in glacial erosion would ascribe to ice work. In the Reppefjelde the cirque floors stand below sea level, so that the shore line enters several curiously rounded bays, suggesting that large blocks had been bitten out of the upland. In another example the cirques have encroached so far on an upland that only a skeleton of it remains. Still other sheets exhibit the 'arm-chair' relation of cirques to the large valley upon which they open, this being a special case of the hanging valley problem. Broad trough-like valleys, with divides on their floors and lateral valleys opening on their walls, are repeatedly illustrated. These various forms are of particular interest when compared with those occurring in a well-dissected, non-glaciated mountain district, such as the old Appalachians of North Carolina, whose forms are well shown on the U. S. Geological Survey topographical sheets around Mt. Mitchell.

W. M. DAVIS.

BOTANICAL NOTES.

MORE BOOKS ON TREES.

NOTHING could show more certainly the rapidly growing interest in trees and their place in the world than the increase in the number of books on this subject. It is but a short time since two books on some phases of forestry were noticed in SCIENCE, and now it is a pleasure to call attention to three more which have appeared within a few weeks. The first is 'The Woodsman's Handbook,' prepared by Professor Graves, of the Yale Forest School, and published as Bulletin 36 of the United States Bureau of Forestry. It is a small book containing 148 pages, each 10 by 16 cm. in size, and so bound and trimmed as to be easily carried in an ordinary pocket. In it the author has attempted to bring together such information in regard to the field work of the forester as he will find necessary to have at hand for use at any moment. It is for the forester what an engineer's 'fieldbook' is to the working engineer. The scope of the little handbook may be seen from the general headings in the table of contents. Here we find 'Units of Log Measure,' 'Measurements of Sawed Lumber,' 'Measurements of Standing Trees,' 'Methods of Estimating Standing Timber,' 'Forest Working Plans,' 'Special Instruments Useful to a Woodman.' Under the first head no less than forty-five log rules are listed and described or commented upon. The author has made a most useful book, and the Bureau of Forestry is to be commended for giving it prompt publication, and especially for bringing it out in this handy form.

The next book is a 'Handbook of the Trees of New England,' by Lorin L. Dame and Henry Brooks, and published by Ginn & Company. It is a book of 196 pages, 10 by 18 cm., and bound with narrow margins for easy carrying in one's pocket. Eighty-seven species of trees are described and figured, and a few more are noticed but not illustrated. The figures are well done and must prove very helpful. The descriptions are full, and as they follow the same order in all cases, they will be useful not only to the forester, but to many a young botanist as well. Under each species the sequence of description is as follows: 'Habitat and range,' 'habit,' 'bark,' 'winter buds and leaves,' 'inflorescence,' 'fruit,' 'horticultural value,' 'explanation of the plate.' It is to be regretted that the authors followed the older nomenclature so largely, but this is not a sufficiently grave defect to seriously mar its usefulness. We wish that other parts of the country had as good books as this on their native trees.

In the 'Economics of Forestry' (Crowell & Company), by Professor Fernow, of the New York College of Forestry, we have another technical book designed for the use of forestry students. It is a work of 520 pages, 12 by 19 cm., and is bound in the usual style for the library shelf. The titles of the twelve chapters will give an idea of the scope of the work, as follows: 'The Relation of the State to Natural Resources,' 'The Forest as a Resource,' 'The Forest as a Condition,' 'Forest and Forestry Defined,' 'Factors of Forest Production and Business Aspects,' 'Natural His-

tory of the Forest,' 'Methods of Forest Crop Production, Silviculture,' 'Methods of Business Conduct, Forest Economy,' 'Principles and Methods of Forest Policy,' 'Forest Policies of Foreign Nations,' 'Forest Conditions of the United States,' 'The Forestry Movement in the United States.' There is also an appendix of valuable notes and tables. From the titles of the chapters, as well as that of the book, it is seen that it deals with the forestry problem from the standpoint of the political economist, and is in fact a contribution to one phase of this science, as well as to technical forestry. A full and satisfactory index closes this timely book, which we are sure must find its way into general use by all who are interested in the subject of forestry in any of its more general aspects.

CHARLES E. BESSEY.
UNIVERSITY OF NEBRASKA.

SCIENTIFIC NOTES AND NEWS.

THE Nobel prizes for 1902 were formally awarded on December 10. As we have already announced, the prize in chemistry was awarded to Professor Emil Fischer, of Berlin; the prize in medicine to Professor Ronald Ross, of Liverpool University, and the prize in physics was awarded divided between Professor H. A. Lorentz, of Leiden, and Professor P. Zeeman, of Amsterdam. The value of each of the prizes is about $40,000.

THE American Philosophical Society elected officers on January 2 as follows: *President,* Edgar F. Smith; *Vice-Presidents,* George F. Barker, Samuel P. Langley, William B. Scott; *Secretaries,* I. Minis Hays, Edwin G. Conklin, Arthur W. Goodspeed, Morris Jastrow, Jr.; *Treasurer,* Henry La Barre Jayne; *Curators,* Charles L. Doolittle, William P. Wilson, Albert H. Smyth; *Councilors,* George R. Morehouse, Patterson Du Bois, Ira Remsen, Isaac J. Wistar.

AT the Washington meeting of the Astronomical and Astrophysical Society of America the following officers were elected to serve for the ensuing year:

President—Simon Newcomb.
First Vice-President—George E. Hale.
Second Vice-President—William W. Campbell.
Secretary—George C. Comstock.
Treasurer—C. L. Doolittle.
Councilors—E. C. Pickering, R. S. Woodward, Ormond Stone, W. S. Eichelberger.

The time and place of the next meeting were left for subsequent decision by the council.

THE first appointments to the newly established honorary position of associate of the Harvard University Museum are as follows: Andrew Grey Weeks, Jr., of Boston, in zoology; Herbert Haviland Field, Ph.D., of Zurich, in zoology, and Robert LeMoyne Barrett, A.B., of Chicago, in geography. Mr. Weeks is a specialist in Lepidoptera; Dr. Field is the editor of the well-known *Concilium Bibliographicum;* Mr. Barrett is engaged in exploration in Central Asia.

SURGEON GENERAL WYMAN, of the Marine Hospital Service, has returned from California, where he went to investigate the alleged existence of bubonic plague in San Francisco.

THREE members of the scientific departments of Syracuse University have leave of absence for the purpose of study abroad—Dr. Charles W. Hargitt, professor of biology, sails for Naples in January, to be absent one year; Dr. T. C. Hopkins, professor of geology, will study volcanoes and glaciers in Italy, France and Switzerland, and Dr. Harold Pender proposes to repeat his experiments on electricity and magnetism at the University of Paris.

THE state commissioners of education of New South Wales, headed by Dr. G. H. Knibbs, president of the University of Sydney, have come to the United States to study our educational system.

MAJOR RONALD ROSS was given a reception by the Lord Mayor of Liverpool on December 22 in recognition of the award to him of the Nobel prize.

THE curators in the Zoological Museum of the University of Berlin, Dr. Wilhelm Weltner, Dr. Gustav Tornier and Dr. Paul Matschie have been made professors.

WE learn from *Nature* that the First Lord of the Treasury has appointed a committee to inquire and report as to the administration by

the meteorological council of the existing Parliamentary grant, and as to whether any changes in its apportionment are desirable in the interests of meteorological science, and to make any further recommendations which may occur to them, with a view to increasing the utility of that grant. The committee will consist of the Right Hon. Sir Herbert E. Maxwell Bart., M.P. (chairman), Mr. J. Dewar M.P., Sir W. de W. Abney, K.C.B., F.R.S., Sir F. Hopwood, K.C.B., Board of Trade, Sir T. H. Elliot, K.C.B., Board of Agriculture, Dr. R. T. Glazebrook, F.R.S., Mr. T. L. Heath, Treasury, and Dr. J. Larmor, F.R.S. Mr. G. L. Barstow, of the Treasury, will act as secretary to the committee.

THE Medical Society of the District of Columbia held a memorial meeting on December 31, in honor of the late Dr. Walter Reed, Major Surgeon, U.S.A. Addresses were delivered by Dr. S. S. Adams, president of the society, Medical Director Marmion, U.S.N., Surgeon J. R. Kean, U.S.A., Professor A. F. A. King, Dr. C. W. Stiles, General Leonard Wood, U.S.A., and Dr. W. H. Welch, of Johns Hopkins University.

WE recorded last week the death of Dr. Charles C. Bell, professor of chemistry in the Medical School of the University of Minnesota. Dr. Bell was born at Somerville, Mass., in 1854. He was graduated at Harvard in the class of '76, and spent several years in the study of chemistry abroad. On his return he was connected with the Johns Hopkins University and the Pennsylvania State College. He became a professor in the University of Minnesota thirteen years ago.

THE deaths are announced of Dr. John Young, lately professor of natural history at Glasgow University; of Mr. Henry Stopes, known for his researches in prehistoric archeology; of Dr. Franz Graeff, professor of mineralogy at Freiburg i. B.; of Dr. Johan Lemberg, professor of mineralogy and geology in the University at Dorpat, of Dr. T. Zaaijer, professor of anatomy and embryology in the University of Leiden; and of Dr. Antonio d'Achiardi, professor of mineralogy and geology at the University of Pisa.

A COMPETITIVE examination of the New York Civil Service Commission will be held on January 24 for the position of structural engineer in the State Architect's Office at a salary of $2,000. The duties include calculation of strength and stability of structures, including floors, girders, roofs, columns, walls, piers and foundations, design of roof trusses, inspection of foundation soils, design of water supply systems, and require a knowledge of retaining walls, calculation of quantities, modern steel and concrete construction and road building. Subjects of examination and relative weights: Theoretical and practical questions, 6; experience and education, 2.

MR. ANDREW CARNEGIE has offered to give the city of Philadelphia $1,500,000 for the erection of thirty branch libraries, on the condition that the city provide the sites and $5,000 a year for maintenance for each branch. Mr. Carnegie has also offered to give $100,000 to Camden for a library building.

MR. HENRY PHIPPS, of New York City, has given $300,000 for the establishment in Philadelphia of 'The Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis.'

DR. WILLIAM B. GRAVES, of East Orange, N. J., has presented a well-equipped bacteriological and pathological laboratory to the Orange Memorial Hospital, to be known as the Graves Laboratory.

A PRESS dispatch from Cambridge states that notice has been received at the Harvard Astronomical Observatory of a gift of $2,500 from the Carnegie Institution. The award is for the year 1903 and the money is to be used toward paying the salaries of experts who are to study the large collection of astronomical photographs which have been made by the observatory.

MR. ANDREW CARNEGIE has signalized his acceptance of the vice-presidency of the Iron and Steel Institute of Great Britain by establishing seven student scholarships of an annual value of $500 each for the furtherance of metallurgical research.

The London *Times* states that the Swedish Antarctic exploration ship *Antarctic* left Tierra del Fuego at the beginning of November on its second summer expedition. It was expected that the expedition, after some cartographic work and natural history research in the northern and western portions of the Dirck Gerritz Archipelago, would arrive about December 10 at the winter quarters in Snow Hill Land, where Dr. Nordenskjöld would resume the leadership of the entire expedition. The *Antarctic* will probably return to Port Stanley (Falkland Islands) at the end of February or the beginning of March.

UNIVERSITY AND EDUCATIONAL NEWS.

Dr. D. K. Pearsons, of Chicago, has made a gift of $50,000 to the endowment fund of Pomona College at Claremont, Cal.

General O. O. Howard, president of the board of directors of the Lincoln Memorial University at Cumberland Gap, Tenn., announces that the $200,000 which they desired for the endowment of the school has been raised.

Dr. Gustav A. Andreen, president of Augustana College, at Rock Island, Ill., has sailed for Sweden, where he goes to accept a $29,000 gift from Swedish educators and business men to Augustana College.

A fellowship of the value of four hundred and fifty dollars has been established by the trustees of Smith College for the encouragement of advanced work in philosophy and psychology. It is open to women graduates of not less than one year's standing of Smith and of other colleges, and is awarded annually, subject to renewal at discretion, to the candidate judged best fitted to profit by it. The holder of the fellowship is required to render a certain amount of assistance (not instruction) in the philosophical department, but is free, and is expected, to devote most of her time to some specified line of work under the direction of the instructors and to present a thesis, embodying the results of her studies, at the end of the year. The work so done may be taken to qualify her for an advanced academic degree. Application for this fellowship should be sent, with testimonials and other vouchers, to Mr. H. N. Gardiner, Smith College, Northampton, Mass., by May 1.

At the Ohio State University a veterinary building costing $35,000 and an addition to the chemical building costing $22,000 are now being constructed. Besides these, a building costing $80,000 for the department of civil engineering and drawing will be commenced as soon as the weather will permit, and plans have been ordered for a physics building costing from $80,000 to $90,000. The funds for these structures have all been provided. Each of the buildings will be planned with reference to future additions. The enrolment of the institution during the past term was 1607, a gain of nearly 200 over the corresponding time one year ago.

A new four-story building, 186 x 70 feet, for the departments of mechanical engineering, mining engineering and geology at Lehigh University is in process of construction.

The trustees of Columbia University have voted to designate the physical laboratories for research the Phœnix Physical Laboratories, in memory of Stephen Whitney Phœnix, of the class of '59, who left a large bequest to Columbia.

Dr. J. J. Thomson, F.R.S., for the past eighteen years Cavendish professor of experimental physics at Cambridge University, has been offered by the trustees of Columbia University the chair of physics, vacant by the death of Ogden N. Rood. Professor Thomson was born at Manchester in 1856, and attended Owens College and Trinity College, Cambridge. At Cambridge he was second wrangler and second Smith's prizeman in 1880 and was elected fellow of Trinity College in 1881. In 1884 he succeeded Lord Rayleigh as professor of experimental physics.

Dr. Charles L. Poor, formerly associate professor of astronomy at the Johns Hopkins University, has been appointed lecturer in astronomy in Columbia University.

The general board of studies of Cambridge University has appointed Mr. F. G. Hopkins, M.A., of Emmanuel College, to the office of reader in chemical physiology.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 23, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE UNIVERSE AS AN ORGANISM.**

IF I were called upon to convey, within the compass of a single sentence, an idea of the trend of recent astronomical and physical science, I should say that it was in the direction of showing the universe to be a connected whole. The farther we advance in knowledge, the clearer it becomes that the bodies which are scattered through the celestial spaces are not completely independent existences, but have, with all their infinite diversity, many attributes in common.

In this we are going in the direction of certain ideas of the ancients which modern discovery long seemed to have contradicted. In the infancy of the race, the idea that the heavens were simply an enlarged and diversified earth, peopled by beings who could roam at pleasure from one extreme to the other, was a quite natural one. The crystalline sphere or spheres which contained all formed a combination of machinery revolving on a single plan. But all bonds of unity between the stars began to be weakened when Copernicus showed that there were no spheres, that the planets were isolated bodies, and that the stars were vastly more distant than the planets. As discovery went on and our conceptions of the universe were

* Address before the Astronomical and Astrophysical Society of America, December 29, 1902.

enlarged, it was found that the system of the fixed stars was made up of bodies so vastly distant and so completely isolated that it was difficult to conceive of them as standing in any definable relation to each other. It is true that they all emitted light, else we could not see them, and the theory of gravitation, if extended to such distances, a fact not then proved, showed that they acted on each other by their mutual gravitation. But this was all. Leaving out light and gravitation, the universe was still, in the time of Herschel, composed of bodies which, for the most part, could not stand in any known relation one to the other.

When, forty years ago, the spectroscope was applied to analyze the light coming from the stars, a field was opened not less fruitful than that which the telescope made known to Galileo. The first conclusion reached was that the sun was composed almost entirely of the same elements that existed upon the earth. Yet, as the bodies of our solar system were evidently closely related, this was not remarkable. But very soon the same conclusion was, to a limited extent, extended to the fixed stars in general. Such elements as iron, hydrogen and calcium were found not to belong merely to our earth, but to form important constituents of the whole universe. We can conceive of no reason why, out of the infinite number of combinations which might make up a spectrum, there should not be a separate kind of matter for each combination. So far as we know, the elements might merge into each other by insensible gradations. It is, therefore, a remarkable and suggestive fact when we find that the elements which make up bodies so widely separate that we can hardly imagine them having anything in common, should be so much the same.

In recent times what we may regard as a new branch of astronomical science is being developed, showing a tendency toward unity of structure throughout the whole domain of the stars. This is what we now call the science of stellar statistics. The very conception of such a science might almost appal us by its immensity. The widest statistical field in other branches of research is that occupied by sociology. Every country has its census, in which the individual inhabitants are classified on the largest scale and the combination of these statistics for different countries may be said to include all the interest of the human race within its scope. Yet this field is necessarily confined to the surface of our planet. In the field of stellar statistics millions of stars are classified as if each taken individually were of no more weight in the scale than a single inhabitant of China in the scale of the sociologist. And yet the most insignificant of these suns may, for aught we know, have planets revolving around it, the interests of whose inhabitants cover as wide a range as ours do upon our own globe.

The statistics of the stars may be said to have commenced with Herschel's gauges of the heavens, which were continued from time to time by various observers, never, however, on the largest scale. The subject was first opened out into an illimitable field of research through a paper presented by Kapteyn to the Amsterdam Academy of Sciences in 1893. The capital results of this paper were that different regions of space contain different kinds of stars and, more especially, that the stars of the Milky Way belong, in part at least, to a different class from those existing elsewhere. Stars not belonging to the Milky Way are, in large part, of a distinctly different class. Yet, the extent of each of these classes is as great as that of the universe. Throughout the whole of the extent of the latter, we find in one direction a certain class of stars to be pre-

dominant and throughout its whole circuit in other directions, a different class.

This supposition was still farther emphasized through the researches of Seeliger on the distribution of the stars in space. He exclaimed, with what we might regard as a pardonable approach to enthusiasm not common in a mathematical discussion, that the Milky Way was now to be regarded as a single object. Another curious fact is that, within it, the stars, so far as we can yet determine, seem to be equally scattered from one extreme to the other. In two opposite directions, that of the poles of the Milky Way, the number of stars which we see are fewest. Their thickness increases, slowly at first, then more rapidly, until we reach the Milky Way itself. So far as has yet been determined there is a perfect symmetry on the two sides of the Milky Way. If, on one side the stars seem to be a little thicker here than on the corresponding side, the case is the reverse in some other regions. The general rule is that if we take two diametrically opposite directions in the heavens, no matter which, and count the number of stars within a given area of, say, ten square degrees in each of these opposite directions, we shall find the number to be nearly the same. The nearer our directions come to the plane of the Milky Way, the more numerous the stars we shall find in the two opposite cases, but the increase in thickness will not be much greater at one end of our line of sight than at the opposite end. Moreover, if we change the direction of this imaginary diameter of the universe, we shall find that, so long as it makes the same angle with the Milky Way, so long will the number of stars around it remain the same. The statistical evidence also shows us that the stars of the Milky Way are, in a general average, several times as bright as those situated elsewhere.

The feature of the universe which should therefore command our attention is the arrangement of a large part of the stars which compose it in a ring, seemingly alike in all its parts, so far as general features are concerned. So far as research has yet gone, we are not able to say decisively that one region of this ring differs essentially from another. It may, therefore, be regarded as forming a structure built on a uniform plan throughout.

All scientific conclusions drawn from statistical data require a critical investigation of the basis on which they rest. If we are going, from merely counting the stars, observing their magnitudes and determining their proper motions, to draw conclusions as to the structure of the universe in space, the question may arise how we can form any estimate whatever of the possible distance of the stars, a conclusion as to which must be the very first step we take. We can hardly say that the parallaxes of more than 100 stars have been measured with any approach to certainty. The individuals of this 100 are situated at very different distances from us. We hope, by long and repeated observations, to make a fairly approximate determination of the parallaxes of all the stars whose distance is less than 20 times that of α Centauri. But how can we know anything about the distance of stars outside this sphere? What can we say against the view of Kepler that the space around our sun is very much thinner in stars than it is at a greater distance; in fact that the great mass of the stars may be situated between the surfaces of two concentrated spheres not very different in radius. May not this universe of stars be somewhat in the nature of a hollow sphere?

This objection requires very careful consideration on the part of all who draw conclusions as to the distribution of stars in space and as to the extent of the visible

universe. The steps to a conclusion on the subject are briefly these: First we have a general conclusion, the basis of which I have already set forth, that, to use a loose expression, there are likenesses throughout the whole diameter of the universe. There is, therefore, no reason to suppose that the region in which our system is situated differs in any essential degree from any other region near the central portion. Again, spectroscopic examinations seem to show that all the stars are in motion, and that we cannot say that those in one part of the universe move more rapidly than those in another. This result is of the greatest value for our purposes, because, when we consider only the apparent motions, as ordinarily observed, these are necessarily dependent upon the distance of the star. We cannot, therefore, infer the actual speed of a star from ordinary observations until we know its distance. But the results of spectroscopic measurements of radial velocity are independent of the distance of the star.

But let us not claim too much. We can not yet say with certainty that the stars which form the agglomerations of the Milky Way have, beyond doubt, the same average motion as the stars in other regions of the universe. The difficulty is that these stars appear to us so faint individually, that the investigation of their spectra is still beyond the powers of our instruments. But the extraordinary feat performed at the Lick Observatory of measuring the radial motion of 1830 Groombridge, a star quite invisible to the naked eye, may lead us to hope for a speedy solution of this question. But we need not await this result in order to reach very probable conclusions. The general outcome of researches on proper motions tends to strengthen the conclusions that the Keplerian sphere, if I may use this expression, has no very well marked existence. The laws of stellar velocity and the statistics of proper motions, while giving some color to the view that the space in which we are situated is thinner of stars than elsewhere, yet show that, as a general rule, there are no great agglomerations of stars elsewhere than in the region of the Milky Way.

With unity there is always diversity; in fact the unity of the universe on which I have been insisting consists in part of diversity. It is very curious that, among the many thousands of stars which have been spectroscopically examined, no two are known to have absolutely the same physical constitution. It is true that there are a great many resemblances. α Centauri, our nearest neighbor, if we can use such a word as 'near' in speaking of its distance, has a spectrum very like that of our sun, and so has Capella. But even in these cases careful examination shows differences. These differences arise from variety in the combinations and temperature of the substances of which the star is made up. Quite likely also, elements not known on the earth may exist in the stars, but this is a point on which we cannot yet speak with certainty.

Perhaps the attribute in which the stars show the greatest variety is that of absolute luminosity. One hundred years ago it was naturally supposed that the brighter stars were the nearest to us, and this is doubtless true when we take the general average. But it was soon found that we cannot conclude that because a star is bright, therefore it is near. The most striking example of this has been brought out by the researches of Gill on the parallax of Rigel, the brightest star in Orion, and of Canopus, which is, next to Sirius, the brightest star in the heavens. In both these cases the parallax from a long series of measurements, extending through several years, came out just zero. These stars, then, though of the first magnitude, are immeas-

urably distant. A remarkable fact is that these conclusions coincide with that which we draw from the minuteness of the proper motions. Rigel has no motion that has certainly been shown by more than a century of observation, and it is not certain that Canopus has either. From this alone we may conclude, with a high degree of probability, that the distance of each is immeasurably great. We may say with certainty that the brightness of each is thousands of times that of the sun and with a high degree of probability, that it is hundreds of thousands of times. On the other hand, there are stars comparatively near us of which the light is not the hundredth part that of the sun.

The universe may be a unit in two ways. One is that unity of structure to which our attention has just been directed. This might subsist forever without one body influencing another. The other form of unity leads us to view the universe as an organism. It is such by mutual action going on between its bodies. A few years ago we could hardly suppose or imagine that any other agents than gravitation and light could possibly pass through spaces so immense as those which separate the stars.

The most remarkable and hopeful characteristic of the unity of the universe is the evidence which is being gathered that there are other agencies whose exact nature is yet unknown to us, but which do pass from one heavenly body to another. The best established example of this yet obtained is afforded in the case of the sun and the earth.

The fact that the frequency of magnetic storms goes through a period of about eleven years, and is proportional to the frequency of sun spots, has been well established. The recent work of Professor Bigelow shows the coincidence to be of remarkable exactness, the curves of the two phenomena being practically coincident so far as their general features are concerned. The conclusion is that spots on the sun and magnetic storms are due to the same cause. This cause can not be any change in the ordinary radiation of the sun, because the best records of temperature show that, to whatever variations the sun's radiation may be subjected, they do not change in the period of the sunspots. To appreciate the relation, we must recall that the researches of Hale with the spectroheliograph show that spots are not the primary phenomenon of solar activity, but are simply the outcome of processes going on constantly in the sun which result in spots only in special regions and on special occasions. It does not, therefore, necessarily follow that a spot does cause a magnetic storm. What we should conclude is that the solar activity which produces a spot also produces the magnetic storm.

When we inquire into the possible nature of these relations between solar activity and terrestrial magnetism, we find ourselves so completely in the dark that the question of what is really proved by the coincidence may arise. Perhaps the most obvious explanation of fluctuations in the earth's magnetic field to be inquired into would be based on the hypothesis that the space through which the earth is moving is in itself a varying magnetic field of vast extent. This explanation is tested by inquiring whether the fluctuations in question can be explained by supposing a disturbing force which acts substantially in the same direction all over the globe. But a very obvious test shows that this explanation is untenable. Were it the correct one, the intensity of the force in some regions of the earth would be diminished and in regions where the needle pointed in the opposite direction would be increased in exactly the same degree. But there is no

relation traceable either in any of the regular fluctuations of the magnetic force, or in those irregular ones which occur during a magnetic storm. If the horizontal force is increased in one part of the earth, it is very apt to show a simultaneous increase the world over, regardless of the direction in which the needle may point in various localities. It is hardly necessary to add that none of the fluctuations in terrestrial magnetism can be explained on the hypothesis that either the moon or the sun acts as a magnet. In such a case the action would be substantially in the same direction at the same moment the world over.

Such being the case, the question may arise whether the action producing a magnetic storm comes from the sun at all, and whether the fluctuations in the sun's activity, and in the earth's magnetic field may not be due to some cause external to both. All we can say in reply to this is that every effort to find such a cause has failed and that it is hardly possible to imagine any cause producing such an effect. It is true that the solar spots were, not many years ago, supposed to be due in some way to the action of the planets. But, for reasons which it would be tedious to go into at present, we may fairly regard this hypothesis as being completely disproved. There can, I conclude, be little doubt that the eleven-year cycle of change in the solar spots is due to a cycle going on in the sun itself. Such being the case, the corresponding change in the earth's magnetism must be due to the same cause.

We may, therefore, regard it as a fact sufficiently established to merit further investigation that there does emanate from the sun, in an irregular way, some agency adequate to produce a measurable effect on the magnetic needle. We must regard it as a singular fact that no observations yet made give us the slightest indication as to what this emanation is. The possibility of defining it is suggested by the discovery within the past few years, that under certain conditions, heated matter sends forth entities known as Röntgen rays, Becquerel corpuscles and electrons. I can not speak authoritatively on this subject, but, so far as I am aware, no direct evidence has yet been gathered showing that any of these entities reach us from the sun. We must regard the search for the unknown agency so fully proved as among the most important tasks of the astronomical physicist of the present time. From what we know of the history of scientific discovery, it seems highly probable that, in the course of his search, he will, before he finds the object he is aiming at, discover many other things of equal or greater importance of which he had, at the outset, no conception.

In his study of what is going on among the stars, even the astronomer may for a time fail to grasp the true significance of what he sees through leaving out of account the vastness of the field which he is surveying. A remarkable case of this is seen in the case of the new stars which have been known to burst forth from time to time. In at least two notable cases of this kind within the past ten years, such stars have been found, within a few months after their outburst, to be changed into or surrounded by a nebula. Nothing could, at first sight, seem more natural or easily explained than this occurrence. To whatever cause we may attribute such a catastrophe as the sudden multiplication, within the period of two or three days, of the light of a sun by thousands of times, the cataclysm must result in throwing out a mass of incandescent vapor, rising with great speed. This vapor expanding on all sides, will appear to us as a nebula surrounding the star and continually enlarging. That any difficulty can stand in the way of this view will first appear when we make an estimate of the prob-

able extent of such a nebula. To do this requires that we know something of the distance of the star. This can not be determined by any absolute method, so that our conclusions as to the distance must in part be conjectural. Yet we can say with a high degree of probability that the annual parallax of these new stars can scarcely be much greater than the thousandth of a second. We have two independent bases for this conclusion.

One is that such stars have never blazed forth except in the regions of the Milky Way. We are, therefore, justified in believing them as distant as the Milky Way. Now one of the results of stellar statistics which we need not stop to reason out at the present time is that the distance of the Milky Way can scarcely be much less than that corresponding to the parallax I have indicated. Even this distance falls far short of the estimates of Sir William Herschel, who is stated to have placed the outermost visible stars of our system at a distance which light would require many thousand years to traverse. He supposed us to see all the stars of the Milky Way by pre-Adamite light. But the distance which I have indicated is that over which light would travel in about 3,400 years.

The other argument on the subject may be briefly stated in this form. From what we know of the thickness of the stars in our immediate neighborhood, there is every reason to believe that, out of several hundreds of million of stars in the universe, not more than twenty thousand are within the distance corresponding to a parallax of 0″.02. The chances are, therefore, more than ten thousand to one that any star in the universe, taken at random, would lie within this range of distance from us.

Another reason for placing the Milky Way, and with it the new stars, at this distance is found in the absence of proper motions from such stars. Most careful and refined measures made by Barnard on Nova Persei show a motion of only 0″.01 in the course of a year, which is only saying that no motion has been seen. Although this result is not conclusive, it affords additional very strong evidence in favor of the view that this star was really in the region of the Milky Way.

Assuming, then, that the distance is of this order of magnitude, let us ask at what speed a nebula must rise in order that it may expand as rapidly as observation seems to show the matter around Nova Persei to have flown outward. Calculations would show this speed to beggar all our conceptions. The highest speed which matter has been known to reach is that attained by the eruption of hydrogen and other gases from the sun, which sometimes amounts to several hundred miles a second. But matter moving only with such a speed as this would require centuries to form a nebula of appreciable size at the distance we have assigned to the new stars.

The application of this principle to the case of Nova Persei led to an ingenious suggestion by Kapteyn that the seemingly slow expansion of the nebula which surrounds Nova Persei was not a motion of matter at all, but only an illumination of nebulous matter already existing by the wave of light thrown out from the exploded star. At first sight the reply to this suggestion might be that the observed expansion can not come up to light in speed. One might be astonished to hear that, inconceivably swift as is the motion of light, it might be well that, at such a distance, it would seem to us as slow as the apparent expansion of the nebula in question. But when we put the matter into cold figures, we find that the great difficulty in the way of accepting Kapteyn's explanation is the opposite of this. What we have to deal with is not the apparent slowness of the motion, but the in-

adequacy of the speed of light to explain the phenomena. If the distance of this star is only 400 times that of α Centauri, the speed of the apparent expansion must have been ten times that of light.

Of all agencies known to be propagated through space in time, light is the swiftest in its motion. We may, therefore, say that no known cause coming into action in February, 1901, could, within the twenty-two months which have since elapsed, have emanated from the star so as to make itself felt outside of a sphere which, at the distance in question, would subtend to our eyes an angle of more than four minutes in diameter. We seem, therefore, forced to the conclusion that either the illumination or nebulosity surrounding Nova Persei during the summer of 1902 existed independently of the outburst of the star, or there exists in the universe a cause susceptible of transmission with a speed several times that of light.

When we look closely into the matter, we find some difficulty in proposing any hypothesis based on the known action of natural agents. A continual course of self discipline is necessary to enable us to appreciate the real significance of the question. The facts, as I understand them, are briefly these: We see by photography an object in the heavens in which certain changes are going on consisting of variations in the appearance of the illuminated portions. Day after day we see that a certain illumination beginning at a point *A*, no matter where, spreads to a point *B*, and perhaps a point of light, *C*, begins to show itself. The natural conclusion is that something is being propagated. The point *B* has received an emanation from *A* and the point *C* has not appeared spontaneously, but has been connected with something going on at some other point, perhaps the central star. In attributing this propagation to that of anything but light and radiant heat, we are met by the difficulty that all other known natural causes which could have operated in such a case fall short of this in their speed of transmission.

Whichever way we turn we meet with difficulties which seem insuperable in constructing any theory that will explain the observed phenomena. The light theory which I have mentioned is rendered more unlikely from the fact that the latest researches upon the Lick photographs seem to show that the emanation did not go out in straight lines with uniform velocity, but branched off here and there, sometimes in one direction and sometimes in another, with varying speed. There is a difficulty in attributing the apparent expansion to the motion of light which seems yet greater than this. The speed of light is perfectly uniform. The outburst was extremely sudden, it being only two or three days from the time when the star became visible until it reached first magnitude. Under the circumstances the outgoing light-wave would have been a well-defined spherical surface, brighest at a point so near the actual surface that its extent would not be visible at such a distance. The star faded away at a rate which reduced it to one half in a very few days and again to one half in a few days more. The light emanating from such an object would, therefore, have presented to our eyes the appearance of a well-defined luminous circular disc, brightest at the circumference outside of which all would have remained in complete darkness. It is true that, owing to the difference of density of the material reflecting the light, the disc would not have been uniform. It might have many gaps here and there and present a cloudy appearance. But with all these differences the boundary would have been as well defined as if the disc had been turned in a lathe.

This would suggest our having recourse to the corpuscles of which the investigation is now beginning and may be the main subject of physical research during the next generation. But here, if we accept the theoretical result of Professor J. J. Thomson, we meet with the difficulty that these entities can not travel with a greater speed than that of light. Under these circumstances nothing seems left for us in the present state of our knowledge but to turn over to our successors the problem of explaining the phenomena.

The main point I desire to bring out in this review is the tendency which it shows towards unification in physical research. Heretofore differentiation—the subdivision of workers into a continually increasing number of groups of specialists—has been the rule. Now we see a coming together of what, at first sight, seem the most widely separated spheres of activity. What two branches could be more widely separated than that of stellar statistics, embracing the whole universe within its scope, and the study of these newly-discovered emanations, the product of our laboratories, which seem to show the existence of corpuscles smaller than the atoms of matter? And yet, the phenomena which we have reviewed, especially the relation of terrestrial magnetism to the solar activity, and the formation of nebulous masses around the new stars, can be accounted for only by emanations or forms of force, having probably some similarity with the corpuscles, electrons and rays which we are now producing in our laboratories. The nineteenth century, in passing away, points with pride to what it has done. It has become a word to symbolize what is most important in human progress. Yet, perhaps its greatest glory may prove to be that the last thing it did was to lay a foundation for the physical science of the twentieth century. What shall be discovered in the new fields is, at present, as far without our ken as were the modern developments of electricity without the ken of the investigators of one hundred years ago. We can not guarantee any special discovery. What lies before us is an illimitable field, the existence of which was scarcely suspected ten years ago, the exploration of which may well absorb the activities of our physical laboratories, and of the great mass of our astronomical observers and investigators for as many generations as were required to bring electrical science to its present state. We of the older generation can not hope to see more than the beginning of this development, and can only tender our best wishes and most hearty congratulations to the younger school whose function it will be to explore the limitless field now before it.

S. NEWCOMB.

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*PLANS OF THE NEW BUILDINGS FOR THE NATIONAL BUREAU OF STANDARDS.**

THE work for which the National Bureau of Standards was established includes research and testing in the domain of physics, extending into the field of chemistry on the one hand and of engineering on the other. The union of research and testing in one institution is of supreme importance, the investigations being, of course, primarily designed to carry the work of standardization and testing to the highest possible efficiency. The Physikalisch-Technische Reichsanstalt is an illustrious example before all the world of how much can be accomplished where research and testing are combined in one institution; and that the union should be intimate is further shown by the fact that more or less research is carried on in the second, or technical, division of the Reichsanstalt, instead of being confined to the first

* A paper read before the Philosophical Society of Washington, October 25, 1902.

division, which is especially the division of research.

At the very outset the director of the Bureau of Standards realized the advantages of this intimate association of research and testing, and no attempt was made or will be made to separate them into two divisions. The laboratory requirements are, therefore, those of a research laboratory plus whatever special facilities may be needed for commercial testing. In addition to the workers themselves there is then required: (1) A suitable place in which to work; (2) an equipment of apparatus, tools and machines; and (3) facilities and appliances for providing the proper conditions for experimental work.

To meet these requirements Congress has already authorized the expenditure of $25,000 for a site, $325,000 for buildings, and $40,000 for equipment. Further appropriations for equipment and personnel will be made as needed.

The site lies in the northwestern suburbs of Washington, about three and one half miles from the Treasury and 1,000 feet from Connecticut Avenue, just north of Cleveland Park. It is 350 feet above the Potomac, and is the highest ground in that vicinity. Complete freedom from the jarring of street traffic is assured, and magnetic disturbances due to the only electric railway in that immediate region will be very slight.

1. Two buildings have been planned, one of which is now under construction; the plans for the other are completed and its construction will soon begin. The larger of the two, which is called the physical building, will provide for that part of the experimental work which ought to be kept free from mechanical and magnetic disturbances, and to this end will contain scarcely any machinery. It will also contain the offices for administration and the library, and a well-equipped chemical laboratory. The mechanical laboratory contains the mechanical plant, instrument shop, and laboratories for the heavier kinds of experimental work, where considerable power or large electric currents are required. These two buildings are to be united by a spacious tunnel, through which air ducts, steam, gas and water pipes, and electric circuits are to be carried from the mechanical to the physical laboratory. The mechanical laboratory was begun last July, and will cost about $125,000, including the heating and ventilating plant. The physical building will cost about $200,000 exclusive of equipment and including the connecting tunnel.

2. Considerable progress has already been made in procuring an equipment of apparatus, tools and machines. In addition to the fifteen rooms in the U. S. Coast and Geodetic Survey buildings, occupied by the bureau last year, a large four-story residence at 235 New Jersey Avenue, SE., has recently been leased and equipped as a temporary instrument shop and laboratory. A small brick building in the rear has been converted into an engine and dynamo room, and in the basement of the house a storage battery room and a second dynamo room, the latter for a distributing switchboard and experimental alternators, have been fitted up. A storage battery of 132 cells, of 200 ampère hours capacity, furnishes power for current and lighting and experimental purposes. A low voltage battery giving 1,000 ampères, and two high voltage batteries of 1,000 cells each, have also been provided. During the past year the director and two other officers of the bureau (Drs. Wolff and Waidner) have visited the principal government laboratories and instrument makers of Europe. The instrument shop is well

equipped with motor-driven machines and hand tools, and two mechanicians and a carpenter are now at work. The apparatus and machinery now in use in the temporary quarters is a part of the permanent equipment of the new buildings. A considerable sum of money will, of course, be needed to complete the equipment.

3. The facilities and appliances for carrying on an experiment under the proper conditions are more difficult to secure than the apparatus itself. In general, laboratory rooms should be well lighted and ventilated, and their temperature should be under control. The windows should be double, in order that the space near the windows (often the most valuable in the laboratory) may be warmer in cold weather and cooler in warm weather, and freer from drafts of air, than would be the case with single windows. It should be possible quickly and conveniently to darken many if not all the rooms. The temperature of the laboratory should be automatically controlled by thermostats, so that any temperature (within certain limits) which may be required by a particular experiment or investigation may be maintained, both day and night if necessary for any desired period. The humidity of the air should be low, so that moisture developed in the room either by respiration or evaporation may be absorbed by the air and carried away instead of depositing on the walls and furniture of the room and apparatus. These last considerations, the control of the temperature and humidity of the air, are vital. Many kinds of work can, ordinarily, be done only in the winter months, because summer temperature and summer humidity can not be controlled. This involves not only long delays, but perhaps a large amount of extra labor. This is perhaps oftenest the case in electrical work, but in many other instances it is equally important. Apparatus, tools and machines often suffer by rusting in summer, in spite of the fact that the attendant means to be careful. Hence, in a laboratory where work is to be carried on during the entire year, and where a large quantity of valuable apparatus and instruments of precision are in use, and where, in addition, valuable apparatus is to be received from outside for testing, the necessity of controlling the humidity as well as the temperature of the room is evident.

The temperature of a room may be automatically controlled by means of a thermostat, using either steam or hot air for heating. Hot air, however, possesses three important advantages over steam. In the first place, steam pipes occupy valuable space in a laboratory, usually near the windows or along the walls, where apparatus or benches would otherwise be placed. If they are of iron, their magnetization by the earth's field changes with their temperature, and since the temperature of the room is regulated automatically by shutting off and readmitting the steam, this causes frequent and annoying changes in the magnetic field within the room. In the second place, heating by air affords the best possible ventilation, which is apt to be insufficient in a steam-heated building. And in the third place, heating by air enables the temperature to be automatically controlled in the summer as well as in winter if facilities are provided for cooling the air, and at the same time the humidity may be controlled by partially drying the air. The air of an unventilated laboratory soon becomes saturated with moisture due to respiration and evaporation; and if it be ventilated by allowing hot, moist air from without to enter, the humidity rises as the temperature falls

and the air is unable to carry away moisture generated in the laboratory.

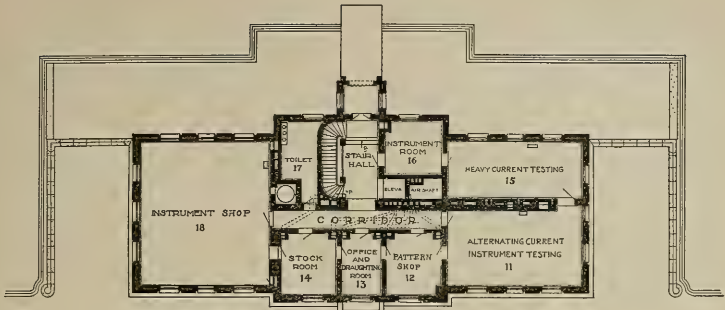
In heating a building by the double-duct system, hot air from one duct is mixed with cooler, tempered air from a second duct in such proportions as to hold the temperature of the room constant, the proportions of the hot and tempered air being regulated by a pair of dampers, the latter being automatically controlled by means of a thermostat. Each room of a building, therefore, has its own supply flue, regulating dampers and thermostat. The latter may be set at any desired temperature within the range of the apparatus. If now in hot weather the hot-air duct of winter carries air taken from out of doors, say at 90° F., and the tempered-air duct carries artificially cooled air, say at 60°, a mixture of the two may give a room temperature of 75° when the temperature would otherwise be 80° or 85°. And the thermostat will adjust automatically the proportions of cooled and uncooled air, so as to hold this temperature constant, thus preventing the usual gradual increase of temperature as the day progresses. By a readjustment of the thermostat any other constant temperature can be secured, provided it is within the range of the system.

Not only will this system make possible automatic temperature control in summer —a most important end in itself—but it will also secure a humidity control. For by cooling air its moisture is partly removed, and by lowering its temperature to the freezing point it is very largely removed. In order to remove as much moisture as possible, it is intended to overcool the air and then partly warm it up again, and this may be done economically by means of a heat exchanger, *i. e.*, air on its way to the cooling chamber gives up heat through a thin metal wall to the overcooled air coming from the cooling chamber; a given refrigerating capacity will thus remove the maximum quantity of moisture, so that the percentage humidity of the air may be no greater at the lower room temperature than, under normal circumstances, it would be at the higher temperature.

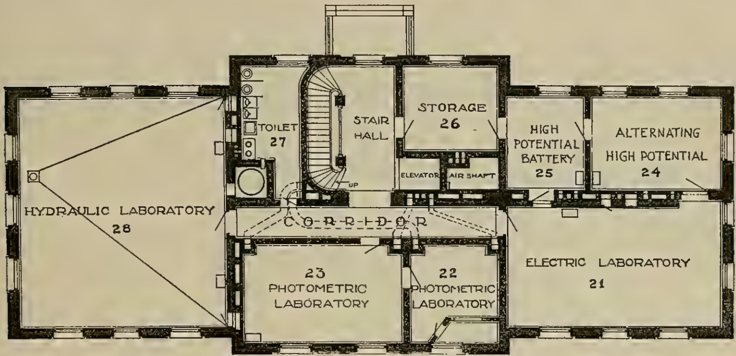
With this system of heating in winter and cooling in summer, with automatic temperature control the year round, with excess of moisture simultaneously removed by refrigeration, and dust from the fresh air taken out by filters, the double windows of the laboratory will be kept tightly closed in summer as in winter, and an atmosphere favorable for experimentation may at any time be secured. The closed double windows will also effectually keep out dust and dirt, two of the enemies of the experimentalist. With gas, compressed air, vacuum, hot and cold water, ice water and distilled water always at hand; with cold brine, carbon dioxide and liquid air always available for low temperatures, and gas and electric furnaces available for high temperatures; with direct electric currents, at potentials up to 20,000 volts and currents up to 20,000 ampères, and still higher alternating voltages and larger alternating currents always available, it is believed that the facilities and appliances necessary for carrying on a wide range of experiments under favorable conditions will be fairly well realized.

THE MECHANICAL LABORATORY.

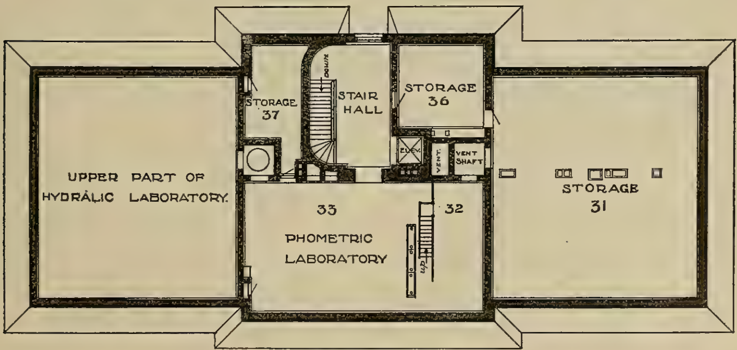
The mechanical laboratory is being built of dark red brick, trimmed with Indiana limestone. It stands on ground sloping toward the north, so that the basement story is wholly above ground on the north, but comes only a few feet above ground on the south. The building is 135 feet long east and west, and 48 feet wide north and



FIRST FLOOR PLAN.



SECOND FLOOR PLAN.



ATTIC FLOOR PLAN.
THE MECHANICAL LABORATORY.

south at the ends, and 58 feet in the central portion. An extension of the basement, wholly below the ground level on the south, is 20 feet wide and projects 25 feet east and west beyond the main portion of the building. This increases the floor area of the basement by 50 per cent., affording ample accommodation for the mechanical plant on this floor.

The boiler room is 42 feet square and 19 feet high, the floor being 5 feet below the engine room floor, and, like the engine and dynamo room, it is lined with white enameled brick. Two water-tube boilers, of 125 horse-power each, are to be installed, and space will be reserved for two other, giving a final capacity of 500 horse-power. The boilers will be fed by automatic stokers, and induced draft will be furnished by a pair of blowers, driven by small steam-engines so governed as automatically to hold a constant steam pressure in the boilers. The smoke flue extends only a little above the roof, and the furnaces will be operated to give as nearly as possible smokeless combustion. Water and air pumps, filters, boiler feed pumps, pressure tanks and other auxiliary apparatus will be located on a platform at the north side of the boiler room, on the engine floor level.

The engine and dynamo room is 87 feet long, and has an average width of 24 feet. The end toward the boiler room will contain two 80-horse-power high-speed steam-engines, each directly connected to two 25-kilowatt dynamos, each giving 200 ampères at 125 volts and connected in a three-wire system, the total capacity, therefore, amounting to 100 kilowatts. Space is reserved for a third engine of 160 horse-power, to drive generators of 100 kilowatts capacity. The western half of this room will be occupied by a number of alternating-current dynamos directly driven by electric motors. These will furnish singlephase and polyphase current for experimental purposes. Several such machines are now being constructed, and others are yet to be ordered. There will be machines with smooth-core armatures and specially shaped pole pieces to give sine waves, others to give distorted waves, and still others to give several harmonic waves which may be combined in various ways to give different wave forms. On the south side of the engine room a switchboard will carry the controlling apparatus for all these dynamos and motors, and also for several storage batteries, and for distributing current to the various laboratory rooms of both buildings. Both live and exhaust steam pipes will be located in the subbasement under the engine room floor.

The refrigerating room is 41 × 18 feet, and will contain an ammonia refrigerating machine, a liquid-air machine, and a small ice-making plant. The refrigerating machine will have a capacity equivalent to the melting of thirty tons of ice per day. A large tank, filled with calcium chloride brine, will be placed in a room in the subbasement just under the refrigerating machine, and will enable 'cold' to be stored equivalent to ten tons of ice. This may be used at night, when the refrigerating machine is not running, or may be used to supplement the machine in the hottest part of the day, if necessary.

The storage battery room is 61 feet long, and will contain several batteries, which will furnish current to motors driving alternators, ventilating fans, the machines of the instrument shop, lights in the buildings when the engines are not running, and current for experimental purposes.

The air-cooling chamber will contain a large quantity of iron pipe through which cold brine will be pumped, and the air to

be cooled will be blown over these coils of pipe. On one side of this cold room, space will be reserved for placing apparatus which it may be desired to cool, or to perform an experiment at the low temperature of this room. The hall in the center of the basement, which is ten feet wide, leads directly into the tunnel, which is twelve feet wide and on the same level. This tunnel leads directly into the basement of the physical laboratory, located about 175 feet to the south. The heating chamber will contain two banks of steam coils, a larger or 'heating' coil, and a smaller or 'tempering' coil. Air passing through the first is drawn into fan No. 1, while air passing through the second goes along the direction of the dotted line into fan No. 2. When it is desired to cool the air, the latter is diverted and goes along the course of the solid arrows through the cooling chamber to fan No. 2. Each fan has a double discharge, about three fifths of the air passing out of the upper outlet, toward the south and through the tunnel to the physical building, and two fifths going through the lower outlet under the floor of the corridor, to be distributed to the flues of the mechanical building. These blowers are operated by electric motors, and may be driven at different speeds.

The gas machine will produce a gas from gasoline better suited for furnace work, hardening, tempering, etc., than ordinary illuminating gas. This will be piped to all the laboratory rooms.

The large room on the first floor, just above the boiler room, is the instrument shop. This is an important feature of any physical laboratory where research is carried on. Four or five lathes of different sizes and styles, a universal milling machine, shaper, drill press, grinder, circular saw and other machines will be installed, and a complete equipment of hand tools provided. The stock room, drafting room, and pattern shop belong to the instrument shop.

At the instrument room on this floor, instruments for testing will be received and shipped, and apparatus and supplies of the bureau will be received. The heavy current testing laboratory will be provided with eight large storage cells, which, when joined in parallel, will give a current up to 20,000 ampères. They will be charged in series, and may be discharged singly or together in any combination. Shunts and recording wattmeters for heavy current will be tested here. The adjacent room, which is directly over the alternating generator, will be used for testing alternating-current instruments. This will sometimes include an examination of their behavior on different loads, at different temperatures, with currents of different frequencies, different power factors, and different wave shapes. Complete specifications of these factors will be supplied when desired with the results of the test.

Immediately above this room on the second floor, is another electrical laboratory room for alternating- and direct-current experiments, and the magnetic properties of iron, study of transformers, condensers, and cables, under relatively high electromotive forces. Room 24, adjacent, will contain transformers for obtaining still higher alternating voltages for testing insulation resistances; and instruments for measuring alternating voltages up to 50,000 volts or higher will be tested here. Room 25 will contain a storage battery of small cells giving potentials up to 20,000 volts and currents up to 1 ampère at this voltage. Rooms 22 and 23 are to be used for the photometric study and calibration of incandescent lamps, gas lamps, Nernst lamps, etc. Immediately above, on the

attic floor, is a large room for arc-lamp photometry. The hydraulic laboratory extends through the second and attic stories, giving a maximum height of over 25 feet. It will be used for testing gas and water meters, pressure gauges, anemometers, steam indicator springs, etc. Provision has been made for a mercury column in the elevator shaft, so that it can be observed from the elevator platform.

Fresh air taken into the building through an open window on the north side of the second floor (adjacent to one of the photometric rooms) passed up to the filters above, then down the air shaft to the heating and cooling coils of the basement, and thence to the blowers.

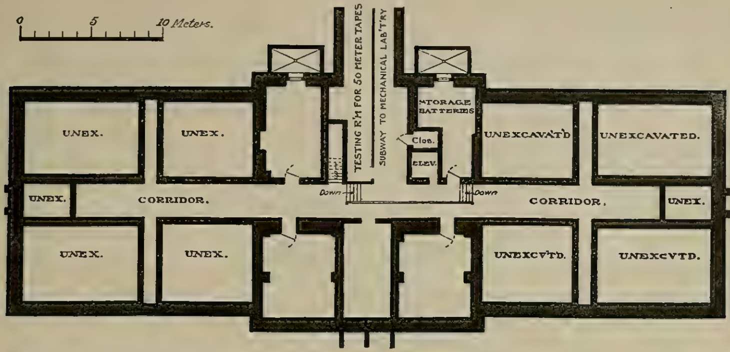
THE PHYSICAL LABORATORY.

The physical building, like the mechanical building, will be built of dark red brick and Indiana limestone, the first story being entirely of stone and the upper stories trimmed with stone. The building is 172 feet long, 55 feet wide, and four stories high, besides a spacious attic story. It faces the south, overlooking the city of Washington.

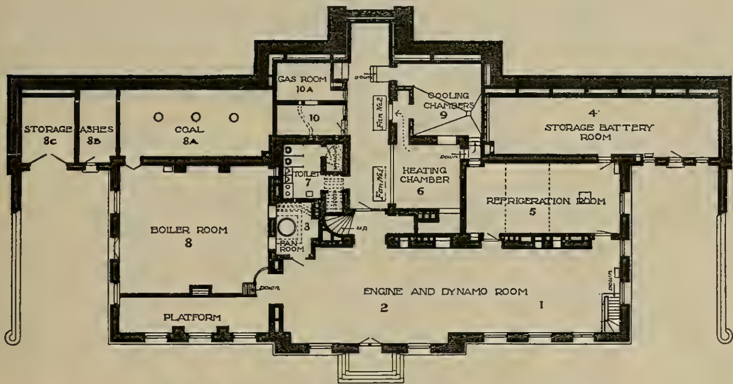
The corridor extends the entire length of the first floor, and the exterior of the building is so designed that if, in the future, additional buildings should be needed, they may be placed one on the east and the other on the west of this building, and connected to it by an arcade opening into the corridor of the first floor. A basement is excavated only under the central portion of the building, and under the corridor, the four large rooms at either end of the ground floor have concrete floors upon which piers may be built as they are found necessary. In one of the basement rooms a storage battery will be installed; the others will be used as constant-temperature rooms for experimental purposes whenever they are needed. Room 4 is a constant temperature room, which will contain the standards of the bureau, and Rooms 13 and 17 are constant-temperature rooms for experimental purposes. All of the rooms of this floor and the floor above, however, will be practically constant-temperature rooms. For with automatic temperature control the temperature can be maintained as nearly constant in these rooms (which have heavy walls and tight double windows) as it could be in any inside or underground room where an observer is working. For the presence of the observer and the heat due to artificial light will disturb the otherwise constant temperature as much or more than the fluctuations in temperature of a room having automatic temperature control. For those cases where a machine or a piece of apparatus is operated without the presence of an observer, as for example a dividing engine, an underground or inside room is better, and several of these have been provided.

A massive-walled, dark, unventilated constant-temperature room is sure to be damp, and is a very poor place for experimental work; there are no such rooms in this building. All of the so-called constant temperature rooms are provided with forced ventilation, although the ventilating air current can be cut off when desired.

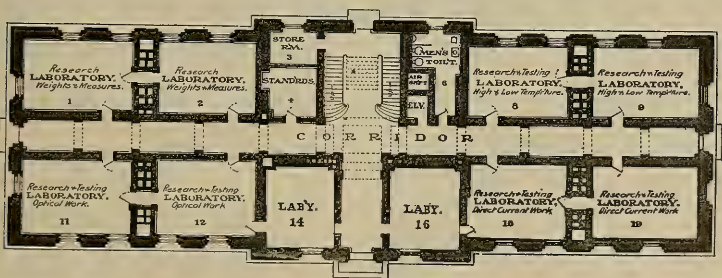
Between Rooms 1 and 2, next to the outer wall, is a vertical shaft three feet square, extending from the basement to the attic, and in corresponding positions are three similar shafts in the other three quarters of the building. All the pipes for distributing gas, compressed air, and vacuum, hot and cold water, ice water, distilled water, cold brine, and all the electric wiring for lighting and experimental purposes are carried up through these



BASEMENT PLAN.



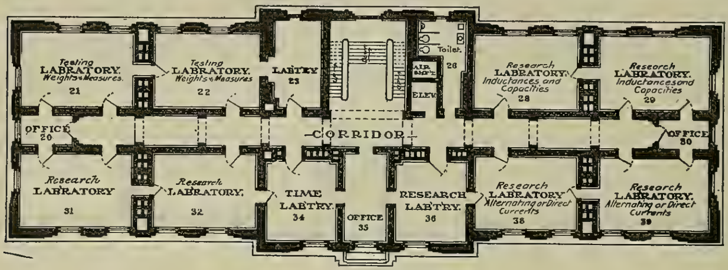
BASEMENT FLOOR PLAN.



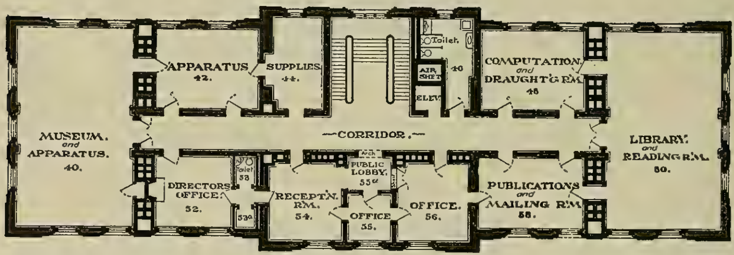
GROUND FLOOR PLAN.

THE PHYSICAL LABORATORY.

shafts. A door opens into each shaft on each floor, making everything accessible without the main pipes and wires being exposed in the laboratories. On each floor branches are brought out from the water pipes to the sinks, from the air and gas pipes to work tables, and from the distributing wires in the shaft to a small switchboard, there being one such switchboard for each suite of two or three rooms in each quarter of the building. The wires connected to these small switchboards run to a main switchboard near the north door of the first floor, and thence trunk lines run through the tunnel to the distributing switchboard of the dynamic room. Thus, through these two main switchboards and a laboratory board any circuit in any laboratory room may be connected to any other circuit in any other laboratory room or to any battery or generator in the mechanical building. The storage battery in the basement will be so connected to the main switchboard that any number of cells from one to the total number may be joined to any laboratory circuit, and an auto-transformer will similarly give any alternating voltage required. Alternating currents of different phases and frequencies may be had at any place by connecting to the proper machine in the dynamo room. An experimenter can then be supplied with any particular kind of electric current by telephoning to the engineer. The pipes and wires are carried to the foot of these vertical shafts through the basement and tunnels which extend under the flues of the partitions



2ND. FLOOR PLAN.



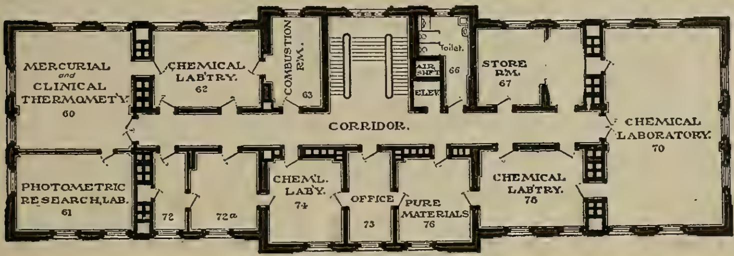
3rd FLOOR PLAN.

between Rooms 1 and 2, etc. Room 1 is 18 × 28 feet, and Room 2 is 18 × 25 feet.

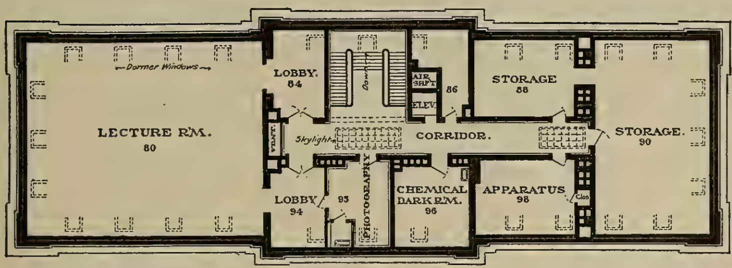
Rooms 1 and 2 will be used as research laboratories for weights and measures, and 21, 22 and 23 will be used for testing weights and measures. This includes masses from a milligram to twenty kilograms, or from a grain to fifty pounds; standards of length up to a meter or a yard; and measures of volume, such as pipettes, burettes, standard flasks, of various capacities up to cubic-foot bottles. Rooms 11, 12, 13 and 14 will be used for research and testing in connection with various methods of making precise mass, length and capacity measurements, including optical methods and optical instruments. Rooms 31 and 32 will be used as general research laboratories, and Room 34 will be used as a laboratory for testing watches, chronometers, clocks, tuning forks and other timepieces.

Rooms 8 and 9 will be used for research and testing of thermometers and pyrometers for measuring temperatures outside the range of mercury thermometers. This will include the use of thermo-couples, platinum thermometers, gas thermometers and commercial pyrometers for high temperatures, such as those used in ovens and furnaces, and of gas, platinum, pentane, toluene and other thermometers for low temperatures down to that of liquid air.

Rooms 16, 17, 18 and 19 will be used for investigation and testing of resistance standards, resistance boxes, and shunts;



4th. FLOOR PLAN.



ATTIC FLOOR PLAN.

standard cells, and instruments used in measuring resistance and electromotive forces. These standards are fundamental to all electrical measurements, and special stress has been laid upon the development of this department.

Rooms 28 and 29 are to be employed for the investigation and testing of standards of capacity and inductance, and for studying problems in which capacity and inductance are involved. Rooms 36, 38 and 39 are to be used for research in other alternating- or direct-current problems.

The third floor provides accommodation at one end for a museum, apparatus and supplies; at the other end for the library and reading room, and in the central portion for the offices of administration. These rooms were placed on the third floor, in order to devote the two lower floors to laboratory purposes—where freedom from mechanical disturbance is of greater importance. The library measures 28 × 48 feet.

Room 61 on the fourth floor is to be devoted to researches on photometric standards, work which will be carried on in connection with the photometric laboratory of the mechanical building. Room 60 will accommodate the work on mercurial thermometers, including ordinary thermometers, precision thermometers, and clinical thermometers. Room 70, at the east end of this floor, is a large general laboratory which may be used for either physical or chemical investigations. The other rooms of this floor will be fitted up as a chemical laboratory, for work in analytical, physical and electrochemistry.

On the fifth floor is to be located a commodious lecture room, which may also be used to some extent as a laboratory; an apparatus room, and two or three storage rooms.

In addition to the heating and ventilating system, in which each room has a flue for supplying fresh air (heated or cooled as the case may be), and a second flue for carrying air away from the room, there is to be a separate exhaust system with a connection to each laboratory room, and also to each toilet room, the storage battery rooms, the hoods of the chemical laboratories, etc. These exhaust flues open down into the basement, where they are gathered into one large duct, which is carried through the tunnel to an exhaust fan in the engine room. This fan will run at a comparatively high speed, and will insure a positive draft at each inlet to the system.

Much thought has also been given to such features of the laboratory equipment as plumbing, work tables, cases, etc., but space forbids giving any particulars.

Edward B. Rosa.
National Bureau of Standards,
Washington, D. C.

AMERICAN PHILOSOPHICAL ASSOCIATION.

Over fifty members attended the second meeting of the American Philosophical Association, held in Washington, in affiliation with the American Society of Naturalists and the other societies meeting under the auspices of the American Association for the Advancement of Science, on December 30 and 31. The affiliation of the association with the scientific societies at this its first meeting following the meeting last Easter, at which it was organized, is significant of the close relation felt to exist between philosophy and the special sciences, a significance emphasized by the fact that a member of the association was this year president of the Society of Naturalists. Probably there was something of the old contempt for abstract speculation on the part of men of science in the good-natured laughter which broke out at the dinner of the naturalists, when it was announced that the psychologists and phi-

losophers were assigned the table at the extreme left of the hall, separating, it was suggested, the philosophic goats as far as possible from the scientific sheep; if so, the laughter might have been turned the other way when, on entering the hall, it was found that the extreme left was at the right of all the presidents of all the scientific societies seated at the high table. Really the present time, symbolized by this affiliation, seems most favorable for mutual understanding and a clearing up of opinion on the important subject of the relations of philosophy and the special sciences. The philosophers, on their part, are now pretty generally agreed that speculation must keep in close touch with experience and with the advances of the natural sciences. Even the most abstract and metaphysical of idealists profess that their systems merely interpret experience, and, as they assume that experience, when properly interpreted, is self-consistent, they too demand that philosophy and science shall be, from the ultimate point of view, one and harmonious, and eagerly endeavor to explain away the glaringly apparent contradictions. Scientists, on the other hand, are becoming increasingly aware of the limitations of their special fields of research and of the purely methodological character of many of their most fundamental hypotheses. A striking illustration of this was given in the Washington address of President Remsen before the Chemical Society, in which, speaking of the atomic hypothesis, he is reported to have said that the conception of the atom had been proved to be illogical, but was, nevertheless, to be retained for the present as a useful device; but as to the dynamics of atoms he frankly admitted that we knew nothing, that they possibly moved in some mysterious way, and that perhaps all chemical phenomena might be due to these motions. There is clearly here little left of the old dogmatism. And as the philosophical aspects of natural science are being more and more recognized by students of philosophy, so, it is to be hoped, the scientific character of philosophy will come to be more and more recognized by men of science. For the function of philosophy is, in fact, largely this, to criticise the categories of science and to develop, from a point of view above that of all the special sciences, the knowledge furnished by every department of experience into a comprehensive science of experience as a whole, *Wissenschaft,* in the large sense of the term.

One of the sessions at the meeting was devoted almost exclusively to one of these aims, the handling, namely, of fundamental conceptions in natural science. Dr. Singer, of the University of Pennsylvania, attempted, in a thoughtful paper, to define the ideal of mechanical explanation; Brother Chrysostom, of Manhattan College, criticised the empirical view of causation; Dr. Spaulding, of Columbia, sought to demonstrate the dogmatic character of the principle, *ex nihilo nihil fit*; and Professor Bawden, of Vassar, defended by new arguments his functional theory of psycho-physical parallelism. At another session questions of a still more general logical nature were discussed, including a critique of cognition and its principles by Dr. Karl Schmidt, of Harvard; an exposition of the function of æsthetic form in judgments of value by Professor R. MacDougall, of New York University; and an examination of logical method in metaphysics by Professor Aikins, of Western Reserve University, the conclusions of the last being decidedly negative as to metaphysics. But the chief interest of the meeting attached to the session of Tuesday afternoon, when the subject, 'What should be our attitude as teachers of philosophy towards religion?'

was discussed by Drs. Miller and Royce, of Harvard; President Patton, of Princeton, and Dr. William T. Harris, of Washington, and to that of Wednesday morning, when the association met with the American Psychological Association and listened to important papers by Professors Münsterberg, Dewey, Ladd, Hibben and Jastrow. For both of these sessions larger rooms had to be secured than those originally assigned to either association. These sessions brought out some interesting differences of view. In the discussion, for instance, Dr. Miller contended that religion and philosophy were entirely independent. Dr. Patton, on the other hand, maintained that religion, if worth anything, is a rational thing and must be rationalized. Professor Royce, in a felicitously worded paper, defined the function of the philosopher in respect to religion as preeminently that of a sympathetic but clear and judicial intellect. The conflicting positions assumed by Professors Münsterberg and Dewey in their papers at the joint session, the conflict having to do with certain aspects of the fundamental question of the relation of knowledge and reality, led to an animated debate in which, besides the principals, Professors Baldwin and Creighton also took part, while Professor Ladd's criticism of psycho-physical parallelism called out a sharp counter-criticism from President G. Stanley Hall. Such discussions are among the most instructive events in a meeting of this sort and exert a decidedly clarifying tendency, even though no very positive result is reached at the time. Without them, papers frequently seem wanting in point, unless they be of such a rarely clear and convincing character as the paper by Professor Hibben, of Princeton, on the philosophical bearings of Ostwald's theory of energetics, or like the address of the president, Professor Ormond, of Princeton, on 'Philosophy and its Correlations,' of which there can be no criticism, but only praise. Of the other papers read at the meeting, it is enough to say that one, by Professor Sneath, of Yale, was on an ethical subject; one, by Professor Horne, of Dartmouth, on the metaphysical aspects of education; two on subjects connected with the philosophy of religion (by Professor French, of Colgate, and Professor Ladd, of Yale), and one a lively criticism of a recent work on personal idealism, the final paper of the sessions, by Professor Caldwell, of Northwestern University. The papers were thus of a very varied character, conducive to the maintenance of interest during the packed four sessions of the meeting, and yet perhaps leaving a somewhat bewildering impression, if there were any one besides the president forced to listen to them all.

One of the most enjoyable features of the meeting was the smoker at the Riggs House immediately following the address of the president on Tuesday evening. The garden of Epicurus could scarcely have afforded a happier combination of philosophical and simply human and friendly social intercourse.

The association elected the following officers for the ensuing year:

President—Professor Josiah Royce (Harvard).

Vice-President—Dr. Edgar A. Singer, Jr. (Pennsylvania).

Secretary-Treasurer—Professor H. N. Gardiner (Smith).

Members of the Executive Committee—Professors William A. Hammond (Cornell) and F. J. E. Woodbridge (Columbia).

The time and place of the next meeting were left with the executive committee.

H. N. Gardiner,
Secretary.

SCIENTIFIC BOOKS.

Dictionary of Philosophy and Psychology. Edited by JAMES MARK BALDWIN, Ph.D. Vol. II. New York, The Macmillan Company. 1902.

In this volume of the 'Dictionary,' the first volume of which was reviewed in Volume XV., No. 373, of this journal, the text of the work is completed. The third and last volume will contain bibliographies. We have very little to add to what has already been said concerning the general character and value of the undertaking. It should always be borne in mind that this dictionary is intended primarily for the student and not for the practised man of research. It aims 'to state formulated and well-defined results rather than to present discussions.' Its worth must be measured by the ideal which it sets itself, and this fact must be kept in view in our criticisms. The question which we shall have to ask ourselves here is, What help does the 'Dictionary' give to persons seeking information?

This question can not be answered indiscriminately, in a word. Some of the articles in this second volume realize their purpose well; others do not. The psychological (normal and abnormal), physiological and general biological subjects are, in my opinion, ably handled. The treatment of the history of philosophy and epistemology is, as a rule, good; it is clear and sound; it does not aim at originality, but bases itself upon standard works. The ethical articles are much better than those in the first volume, though not, to my judgment, fully adequate. The majority of the logical articles are remarkable for their display of historical learning rather than for their utility to the student. They contain a mass of material which one would expect to find in a work like Prantl's 'Geschichte der Logik' instead of in a book like this. Besides, they are often vague, diffuse and polemical, reminding one of the quibbles of the schoolmen, and are not suited to the needs of the persons for whom they are supposed to be intended. The educational articles are few, but their character is not such as to cause one to regret this fact.

The bibliographical material is, as in the former volume, of unequal value. The psychological and biological bibliographies are good, although there is too great a tendency to mention almost every monograph that has been published in the experimental-psychological field. Most of the other bibliographies are not at all adequate. Of course, the third volume may remedy this defect, but the text itself should give the student the greatest possible assistance, and that is not always done, in my opinion. There is no reason why the references under living matter, localization, memory, nervous system, organic selection, optical illusions, reaction time, speech and its defects, spinal cord and vision, for example, should be so full, and those under equally important subjects so very meager. Modern logical books are seldom mentioned; only where the writers of articles are dealing with subjects very near to their hearts, as for example in the case of symbolic logic, do we get satisfactory lists. The educational book-lists are very poor. The habit which some writers have of constantly referring to their own works and even praising them, does not seem to me to be in good taste. I think it would be a distinct gain if we could develop a little more modesty along these lines.

The biographical portion of the 'Dictionary' is the least satisfactory of all. The editor declares in the preface: "And, again, we are not in any way claiming that the treatment of biography is more than the proverbial 'part of a loaf'; it was a question, indeed, of part of a loaf or no bread." But the sins here are not merely sins of omission. Unimportant details are often inserted, and generally no hint is given of what the men described actually stood for. Besides, comparatively unimportant persons are mentioned and important ones left out. We look in vain for such names as Lyell, Machiavelli, Maine de Biran, Mandeville, Marcianus Capella, Karl Marx, Maupertuis, Maxwell, Robert Mayer, Moleschott, Pherecydes, Platner Quintilian, Ratke, Renan, Savigny, Spener, Stirner, Stobaeus, Jeremy Taylor, Tindall, Toland, Tyndall, Vanini, Leonardo da Vinci, Vischer, Whately, Wiclif, Winckel-

mann, but get in their stead: Libelt, J. B. de Mirabaud, Opzoomer, Prevost, Ernst Reinhold, Rothe, Schilling, Schubert, H. C. W. Sigwart, B. H. Smart, Upham, J. Weber, C. Weiss and C. Wright. We cannot expect every one to be mentioned, it is true, but it does seem to me that a biography of Jeremy Taylor, for example, would not have been too dearly bought even if its insertion had made necessary the exclusion say of Upham and Chauncey Wright. Under the rubric 'Philostratus' our attention is called to four Sophists by that name. The most important Philostratus, however, the one who wrote the life of Apollonius of Tyana, in the third century A.D., is omitted.

In addition to the subjects discussed in the 'Dictionary' the following, which are very general in their scope, would not have been out of place: Medieval education, a special article on modern philosophy, modern physical theories, monarchianism, neo-humanism in education, physical culture, primitive christianity, professional education, realgymnasium, realschule, right of sanctuary, school-reform in Germany, secondary schools, social virtues, specialism, sermonism, subordinationism, tolerance, universities, Waldenses. The account of the Renaissance is very meager, but we are referred in it to 'Humanism,' which is also incomplete and refers us back to 'Renaissance.' We are frequently referred to a topic, 'Terminus,' but the topic never turns up. The same statement applies to 'Victorines.' Under 'Preexistence' we are told to look for 'Transmigration.' When we turn to this subject we are sent to 'Metempsychosis.' Still these are minor annoyances, and no dictionary would, it seems, be complete without them.

The statements on page 51: "It (the form) is the result of the development of matter. He (Aristotle) looks upon the problem from the point of view of the naturalist. In particular, the soul is an outgrowth of the body," are, to say the least, misleading. On page 133 ('Nativity') a false impression is given of the dogma of Immaculate Conception. The dogma of immaculate conception which was defined in 1854 does not refer to Christ's miraculous birth at all, but to the immaculate conception of Mary. That Christ was miraculously conceived was accepted almost from the very beginning, but Pius IX. was the first to set the seal of the Church on the doctrine that Mary 'in the first moment of her conception, by a special grace and privilege of Almighty God, in virtue of the merits of Christ, was preserved immaculate from all stain of original sin.'* On page 421 the following sentence occurs: 'Kant terms his philosophy empirical realism, meaning that it holds to an existence of things in space independent of our particular states of consciousness, opposing it to transcendental realism, which asserts that time and space are something in themselves independent of our sensibility.' This does not seem to me to give Kant's meaning correctly. The Plutarch mentioned on page 496 as having died 120 A.D. is not the Plutarch who belonged to the Neo-Platonic school of Athens. The celebrated Plutarch, author of the 'Lives,' died in the neighborhood of 120. Plutarch the younger, the philosopher referred to on page 496, died 433.

The references which are made to other books are not always definite and exact enough. We are frequently referred to passages in Kant's works, for example, but we are seldom told in which one of the many editions the passages are to be found. Where the references are to translations of works, a statement should be made to that effect.

The lack of uniformity in spelling, etc., to which attention was formerly called, is not so great in this volume as in the other. There are, however, a few points which may be mentioned here. We find Localisation, Lokalisation, localisirt; Pharisäertum, Eigentum, Minderwertigkeit, Tatsachen; Socialisierung; Watts's; Kritik, Critique, Critic; Okham, Occam; Abelard, Abélard; Leibnitz, Leibniz; spacial, spatial. French titles are written with and without capitals.

In conclusion, I should like to call attention to the following mistakes: p. 28, for Machina write Maschine; p. 85, for Atomen,

* Translation from Schaff's 'Creeds of Christendom.'

Atome; p. 113, for present, prevent (the passage from Bentham in which this mistake occurs was evidently taken from Eisler's 'Wörterbuch,' where the same mistake is made); p. 126, for Preyer, Preger; p. 143, for Appendix B, Appendix II.; p. 194, for Fonsgriève, Fonsegrive; p. 269, for Kirchener, Kirchner; p. 270, for 1894, 1874; p. 273, for Appuleius, Apuleius; p. 292, for Herbert, Herbart; p. 456, for fühlen, Fühlen; p. 500, for Natur und Grenzen der Naturwissenschaft, Über die Grenzen des Naturerkennens; p. 533, for Gibert, Gilbert; p. 601, for Puffendorf, Pufendorf; p. 668, for stata, states; p. 823, for Nietsche, Nietzsche. The reference on page 421 to Müller's translation of the 'Kritik' (p. 320–326) should, I suppose, be to pages 300 ff.

The Greek, Latin, German, French and Italian indices which are found at the end of the second volume are useful.

FRANK THILLY.

UNIVERSITY OF MISSOURI.

SCIENTIFIC JOURNALS AND ARTICLES.

The Popular Science Monthly for January contains an excellent account of 'The Missouri Botanical Garden,' by William Trelease, telling of its origin, arrangement and plans for future growth. Alfred C. Haddon makes a plea for 'The Saving of Vanishing Data,' mainly zoological, and A. J. McLaughlin combats 'America's Distrust of the Immigrant' with the aid of various tables showing his various deficiencies. 'Variation in Man and Woman,' by Havelock Ellis, is largely a reply to former criticism by Professor Pearson and tends to show that variation is greatest in man. J. C. Sutherland considers 'The Engineering Mind,' and A. L. Benedict makes a plea for 'Post-graduate Degrees in Absentia.' Frederick Adams Woods presents the sixth of his papers on 'Mental and Moral Heredity in Royalty,' the present being devoted to the Bourbons in Spain, and W. J. Spillman discusses 'Mendel's Law.'

IN *The American Naturalist* for December A. W. Grabau presents some 'Studies of Gastropoda' and W. M. Wheeler describes 'The Occurrence of *Formica cinerea* Mayr and *Formica rudibarbis* Fabricius in America.' The twelfth part of 'Synopses of North American Invertebrates' is by H. S. Pratt, and continues the treatment of the Trematodes, embracing the digenetic forms. This is a long and fully illustrated paper. The number contains the index to Volume XXXVI.

The American Museum Journal for January gives notes on the second Cope collection of fossil vertebrates, on the Eskimo collection from Hudson Bay and on the skeleton of the finback whale recently acquired by the museum. The supplement is a substantial 'leaflet' of thirty pages, fully illustrated, devoted to an account, by W. D. Matthew, of the 'Evolution of the Horse.' This pamphlet should be in demand, as it summarizes our knowledge of this subject in a most admirable manner and brings it down to date.

THE leading article of *The Museums Journal* of Great Britain for December is on 'Technical Museums,' by John MacLauchlan, and is a sketch of the technical museum of Dundee, showing how its collections were brought together at comparatively little cost. Not every museum, however, is so favorably located for acquiring material. The bulk of the number is occupied by reviews of museum reports and with notes. From these last we learn that the collections made by Sven Hedin are now in the Stockholm university college, where they are being arranged and studied.

F. A. LUCAS.

SOCIETIES AND ACADEMIES.

OHIO STATE ACADEMY OF SCIENCE.

THE twelfth annual meeting was held at Columbus, November 28 and 29, with about thirty-five members in attendance. The committee on topographic survey reported that the legislature had granted $50,000 to continue the work in cooperation with the United States Geological Survey in 1902 and 1903. Lynds Jones, of Oberlin, gave an account of work done with aid from the Emerson McMillin research fund to secure data for a catalogue of the birds of Ohio to be published by the Academy. C. Judson Herrick was elected president for the ensuing year; J. A. Bownocker and Miss L. C. Riddle, vice-presi-

dents; Herbert Osborn, treasurer; E. L. Moseley, secretary; F. L. Landacre and T. A. Bonser, members of the executive committee; J. H. Schaffner, trustee and member of the publication committee. Hon. Joseph Outhwaite, president of the newly organized Society for the Prevention of Tuberculosis, addressed the academy on the work of that society.

The following papers were read:

Herbert Osborn: 'Opportunities for Faunal Studies at the Lake Laboratory at Sandusky.'

F. L. Landacre: 'A List of Protozoa Observed during the Summer of 1902.'

Max Morse: 'Ohio Batrachians and Reptiles.'

C. Judson Herrick: 'A Note on the Significance of the Size of Nerve Fibers in Fishes.'

W. F. Mercer: 'Report on the Development of the Bones in the Legs of our Domestic Animals.'

Jas. S. Hine: 'The Tabanidae of Ohio.'

Jas. S. Hine: 'A List of Ohio Syrphidae.'

Herbert Osborn: 'Remarks on the Occurrence of Periodical Cicada in Ohio in 1902.'

Herbert Osborn: 'Note on the Occurrence of the Cigarette Beetle in Columbus.'

Max Morse: 'Unusual Abundance of a Myriopod.'

William R. Lazenby: President's Address—'The Dietetic Value of Fruit.'

Robert F. Griggs: 'New Heliconias from Guatemala and Elsewhere.'

Otto E. Jennings: 'Further Notes on Smut Experiments.'

W. A. Kellerman: 'The Life History Problem of the Heteroecious Rusts.'

H. Herzer: 'Eleven New Species of Fossil Plants.'

Lumina C. Riddle: 'Some Algæ from Sandusky Bay.'

W. A. Kellerman: 'The Three Forms of Prickly Lettuce in Ohio.'

W. A. Kellerman: 'Annual Report on the State Herbarium and Plants New to the State List.'

E. L. Moseley: 'Additions and Corrections to the Sandusky Flora.'

John H. Schaffner: 'The Flora of Chicken Island.'

John H. Schaffner: 'Ohio Station for Myriostoma.'

Wm. C. Mills: 'New Discoveries at the Baum Prehistoric Village Site, Ross County, Ohio.'

Wm. C. Mills: 'The Gartner Mound.'

W. A. Kellerman: 'Two Botanizing Trips in the Mountains of West Virginia.'

H. Herzer: 'Two Fishes from the Upper Helderberg Group.'

Wm. C. Mills: 'The Darnell Mastodon.'

Otto E. Jennings: 'General Climatic Conditions of Ohio.'

Thos. Bonser: 'Some Problems in Montana Forestry.'

Robert F. Griggs: 'Three Interesting Tropical Plants.'

W. A. Kellerman: 'An Ecological Study of West Mansfield Swamp,' preliminary report.

Thos. Bonser: 'Final Report on Big Spring Prairie.'

Lumina C. Riddle: 'Microscopic Life Forms in Brush Lake.'

John H. Schaffner: 'Preliminary Report on the Plant Ecology of Brush Lake.'

Wm. C. Mills: 'Identification of Flint from the Prehistoric Flint Quarries of Licking County, Ohio.'

E. L. Moseley: 'Currents in Sandusky Bay.'

W. A. Kellerman and J. G. Sanders: 'The Ohio Erysiphaceæ—Keys and Distribution.'

Leslie D. Stair: 'Additions to the Cuyahoga County Flora.'

Leslie D. Stair: 'Additions to the State Flora.'

Otto E. Jennings: 'Trees and Shrubs on the Ohio State University Campus, with Dendrological Notes.'

E. L. Moseley: 'The Meteor of September 15.'

John H. Schaffner: 'Report of Progress on the Plant Ecology of Ohio.'

W. A. Kellerman: 'Variation in *Carex lurida*.'

E. L. Moseley,
Secretary.

NORTH CAROLINA ACADEMY OF SCIENCE.

The North Carolina Academy of Science held its first annual meeting at Trinity College, Durham, N. C., on November 28 and 29, 1902. Between thirty and forty persons attended the various sessions, most of whom identified themselves with the organization. Retiring President W. L. Poteat, of Wake Forest, gave an admirable address upon the subject 'Science and Life,' after which the Academy was tendered an informal reception by the faculty and ladies of Trinity College. About fifteen papers were presented in full and briefs of several others given, while still others were presented only by title. A resolution was passed authorizing the publication

of the proceedings of the meeting, to include also the constitution and by-laws. The officers for the ensuing year were selected as follows: *President,* C. M. Edwards, Trinity College, Durham; *Vice-President,* C. E. Brewer, Wake Forest College; *Secretary-Treasurer,* Franklin Sherman, Raleigh; *Executive Committee,* Messrs. C. M. Edwards, Franklin Sherman, F. L. Stevens, W. G. Sackett, H. H. Brimley, C. B. Williams, W. L. Poteat, Chas. Baskerville, Collier Cobb.

F. S.

AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION.

THE fortieth regular meeting of the section was held at the 'Tech Union,' Garrison St., Boston, Friday, December 19, at 8:00 P.M., President A. H. Gill in the chair. About 150 members were present. Dr. Carl Otto Weber, of Manchester, England, gave a very interesting talk on 'India Rubber, its Chemical and Technical Problems,' in which he first described the preparation of the gum from the milk as it exudes from the trees when they are tapped, and showed that the coagulation of the milk is influenced by the albuminous matters which are always present. If these substances are allowed to coagulate with the rubber, it is impossible to remove them afterwards, and they become the source of the injurious fermentation which often occurs in crude rubber. Pure rubber free from albuminous matter, even if shipped wet, will not ferment at the extreme heat to which it is often subjected in the holds of vessels, and arrives at its destination in perfect condition. It is thus of the greatest importance to use a process of curing in which the albumen is removed before coagulation.

Dr. Weber then took up the question of the chemical composition of rubber, showing that rubber, freed from albuminous and resinous substances, no matter from what source the rubber is derived, consists of two substances; one, amounting to four per cent. or less of the total, insoluble in all solvents, contains oxygen, and has the empirical formula, $C_{30}H_{68}O_{10}$; the remainder is a hydrocarbon $(C_{10}H_{16})_n$. As to the constitution of this hydrocarbon, it is undoubtedly a polymer with a very high molecular weight. On dry distillation it gives C_5H_8, isoprene, $C_{10}H_{16}$, inactive limonene, and $C_{15}H_{24}$, the so-called heveëne. The last two compounds are cyclo-terpenes, but isoprene is an open chain compound, with two double bonds, and has the formula,

$$\begin{array}{l} H_2C = \underset{\textstyle H}{\underset{|}{C}} - \underset{\textstyle CH_3}{\underset{|}{C}} = CH_2, \end{array}$$

or 2-methyl-1, 3-butadiene. Isoprene, on standing, polymerizes into rubber, or polyprene as it has been called on this account. There is evidence to show that isoprene is the main primary product of the dry distillation of rubber, and that limonene and heveene are secondary products derived from the isoprene. Rubber forms addition products with chlorine, bromine, etc.; also extremely interesting compounds have lately been discovered, which are formed by the action of oxides of nitrogen on rubber. These compounds, $(C_{10}H_{16}N_2O_3)_2$ and $(C_{10}H_{16}N_2O_4)_2$, are produced quantitatively from all varieties of rubber, and are soluble in many solvents. They, therefore, furnish valuable aid in the analysis of rubber, and open up a very promising road for the further investigation of its constitution. The fact that rubber is a highly polymerized unsaturated hydrocarbon with an open chain, and probably three double bonds for $C_{10}H_{16}$, shows why all attempts to make rubber by polymerizing those terpenes, $C_{10}H_{16}$, which are known to be cyclo-compounds with only two double bonds have not led to success. Attention was also called to the recent work of Kondakoff, who has obtained a compound,

$$\begin{array}{l} H_2C = \underset{\textstyle CH_3}{\underset{|}{C}} - \underset{\textstyle CH_3}{\underset{|}{C}} = CH_2, \end{array}$$

or 2, 3-dimethyl-1, 3-butadiene, which is seen to be a methylisoprene. This substance, on standing, was converted quantitatively into a white spongy mass, tasteless, odorless and insoluble in all solvents, which is probably a methyl derivative of rubber, or methylpolyprene. Thus a very important step has been taken in the synthesis of rubber.

The lecturer also discussed the subject of vulcanization, pointing out that it consists simply in the addition of sulphur, no hydrogen sulphide being formed if pure rubber is used. The result of vulcanization not only depends upon the amount of sulphur, the heat and the time, but also on the state of the rubber at the moment of vulcanization. The amount of sulphur may vary from that necessary to form a compound, $C_{100}H_{160}S$, to that for $C_{100}H_{100}S_{20}$. The state of the rubber can be greatly changed before vulcanization, as for instance by manipulation between rollers, whereupon it becomes more plastic and loses in elasticity. This is due to the breaking down of the molecules, $(C_{10}H_{16})_n$, into molecules of lower molecular weight, that is where (n), which may be 100 or more in crude rubber, becomes a smaller number. This is shown by the fact that the rubber becomes more easily attacked by oxidizing agents, and is in many ways more reactive, as is to be expected from a highly unsaturated compound, where the higher the molecular weight the less easily is the molecule attacked by reagents.

Dr. Weber showed how many of the technical problems that continually occur in the rubber industry can be solved by the application of theoretical considerations, and closed with an appeal for workers on this very interesting but comparatively little investigated field of organic chemistry.

Arthur M. Comey,
Secretary.

TORREY BOTANICAL CLUB.

At the meeting of Wednesday, November 26, 1902, Dr. W. MacDougal spoke on some examples of propagation by bulbils. Two kinds of bulbils were spoken of, namely, those which morphologically are stems, and those that morphologically are roots. He exhibited specimens of *Dioscorea villosa* which bore in the axils of the leaves large bodies described as bulbils of the first sort, and *Ranunculus Ficaria* and *Globba Schomburgkii* which had similarly placed bodies, much smaller, however, which were morphologically roots. In any case the bulbils reproduce the plant by germinating after falling to the ground. Drawings of *Lysimachia terrestis* were shown that represented the changes effected in the habit of the plant brought about by being grown in water.

A specimen of the so-called 'wood-rose' of Guatemala was also presented by Dr. MacDougal. This curious malformation is a hypertrophy of a branch of some species of the Leguminosæ and is caused by an unknown species of *Loranthus*.

Dr. N. L. Britton made remarks on the plant conditions and the general plant formations of the island of St. Kitts, British West Indies. The meeting then adjourned to the conservatories, where the members of the club, under Dr. Britton's guidance, examined some of the plants that have recently been brought to the Botanical Garden from St. Kitts.

W. A. Cannon,
Secretary pro tem.

At the meeting of December 9, 1902, the first paper was by Professor A. P. Selby, on 'Culture of the Grape-rot Fungus,' with exhibition of culture-tubes containing its fully developed spore-sacs and spores, derived from pycnospores upon the grape leaf. This fungus has menaced the industry in Ohio, producing rotting of both fruit and leaf.

The second paper, by Dr. H. H. Rusby, was on 'The Flora of the Orinoco Delta,' a delta extending about 200 miles along the sea, and as far inland, if we include the region of rocky islands and deep rocky river-channels in addition to the area of silt-deposits. It is doubtful if the part visited by Dr. Rusby had been botanically explored before his visit. Its characteristic features are:

1. A hill flora which covers islands never submerged, and rocky banks of the river toward the interior; trees and Bignoniaceous vines characterize it. Mounted sheets exhibited (from Dr. Rusby's collecting) included *Spondias*, the hog-plum, *Anona*, the custard-apple, palms of the genus *Bactris*, and representatives of the many large trees (reaching often 100 feet high) as a *Vitex* of the Verbena family and an *Aliberta* of the Rubia

family; also a *Paullinia,* a woody vine; a *Cupania,* of the Sapindaceæ, etc.

2. A river flora, including a marginal flora on periodically submerged banks and a submerged flora upon islands; chiefly a mass of tangled vines. River-bank trees, of which specimens were shown, included a *Cecropia* of the Fig family; and *Inga,* a relative of the acacia, a tree which becomes a mass of flowers frequented by hundreds of humming-birds. Another tree, *Hecastophyllum,* has its hollow stems always inhabited by myriads of formidable ants with a sting hot as fire. Shrubs of the marginal flora include many with a milky juice, as *Tabernæmontana,* and many gorgeous-blooming species of *Solanum.* Woody vines were largely of the Bignoniaceæ; drinkable water was obtained from one which climbed perhaps 100 feet. Marginal river herbs shown included a *Spigelia,* source of a valuable drug, especially important now that the Spigelia of the southern United States is disappearing. A *Cuphea* with orange flowers made a magnificent display. A *Heliconia* (*H. pendula*) of the Zingiberaceæ, resembles a drooping orchid. *Sphenoclea,* an introduced member of the Lobelia family from India, covered low places. Island trees include several large drupe-bearing species of *Moquilea* and *Licania,* related to our plum, and producing a wood valued there for charcoal-making.

3. Along the setbacks of high-water periods, lakes remain as the water recedes, alternating with partly dried exposed levels, which produce peculiarly dense and terrible swamps. The lakes become covered with vegetation which resembles a meadow at a distance. This swamp flora includes floating and herbaceous aquatics and shrubby thickets like chaparral. Trees occur with roots nearly exposed during the dry season. The swamp flora includes many trees of the Rubia family, with valuable wood; a profusion of shrubby *Lantana* and *Eupatorium;* various vines, as the *Securidaca* of the Polygala family; herbs, as *Jussiæa* of the Onagraceæ, etc.

4. A tidal flora extends some forty miles in breadth along the coast, where the villages are built on piles. The littoral flora at the ocean edge is soon replaced by an inland tidal flora, chiefly of stout fan-leaved palms of different species, from the short spiny palms of the river-margins to the tall smooth palms of the hills.

Dr. Rusby found but few orchids; two exhibited were a beautiful *Ionopsis* and a *Habenaria* of curious floating habit, growing where the water beneath was fifteen feet deep. One of the palms occurring there is remarkable for its elevated base, raised about four feet by means of spiny outward stilts (roots?); its smooth trunk rises upward about forty feet.

In answer to inquiries, Dr. Rusby said that his collections were made during six weeks, beginning in April; that though he found many flowers, he concluded that flowering and seed production at any time is comparatively the exception in the tropics, nature relying chiefly on the continuance of plants by vegetative processes. Much of the country visited was uninhabited; the Imataca Mountains, about twenty-five miles distant, had never, it would seem, been visited even by the Indians of the region. Dr. Rusby attempted to penetrate through the twenty-five miles of swamp in vain, making but nine miles in three weeks, and then turning back exhausted with forcing his way over the swamp water. Two of his men, with boards fastened to the feet somewhat in the manner of snowshoes, afterwards crossed the swamps to these mountains, and were rewarded by the discovery of a 'lace-work fall' hundreds of feet in height, but from inaccessible cliffs.

The evening's program closed with the exhibition by Dr. Underwood of a sterile mycelium of a fungus of the nature of a *Polyporus,* growing recently beneath the new North German Lloyd docks.

EDWARD S. BURGESS,
Secretary.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

November 21.—Professor J. F. Kemp reviewed 'Etude sur le Point de fusion des mineraux et sur les consequences petrographiques,' par A. Brun. He then reviewed an unpublished paper by Professor W. C.

Knight and himself on the 'Leucite Hills of Wyoming.' This joint paper was given at the Washington meeting of the Geological Society of America.

December 12.—Dr. Julien reviewed a paper in a late number of the *Bulletin de la Société Belge de Geologie* on the origin of the curious granite enclosed in the arkose of the St. Etienne coal basin.

Professor Grabau presented a very interesting paper on the origin of limestones. This was presented at the Washington meeting of the Geological Society of America.

H. W. Shimer.

DISCUSSION AND CORRESPONDENCE.

FIRST RECORD OF THE POLLACK WHALE (BALÆNOPTERA BOREALIS) IN THE WESTERN NORTH ATLANTIC.

To the Editor of Science: I am in receipt of reliable information that during the season of 1902 four finback whales of a species corresponding to, or identical with, *Balænoptera borealis* Lesson were taken at the whaling station at Rose-au-Rue, Placentia Bay, Newfoundland. This is the first authentic record of this form of finback in the western North Atlantic. The species is called 'Sejhval' (pollack whale) by the Norwegian whalers. Whether the species taken at Newfoundland is really identical with the European species can of course only be determined by examination of specimens.

The species named *B. tuberosa* by Cope, on the basis of a specimen killed in Mobjack Bay, Virginia, may be the same as the Newfoundland pollack whale, but the description of that species is inadequate for a positive determination, and the whereabouts of the type is at present uncertain. It is quite as probable that the Mobjack Bay whale represented *B. physalus* L.

The Newfoundland whale fishery, which was established in 1898, has grown to large proportions. The kinds of whales taken are the humpback (*Megaptera nodosa*) and three species of finbacks, namely, the common finback (*Balænoptera physalus* L.), the sulphur-bottom (*B. musculus* L.) and, as just noted, the pollack whale (*B. borealis*, or an American representative of that species).

According to the figures kindly placed in my hands by Dr. L. Rissmuller, more than 450 whales were taken at the Newfoundland stations during the season of 1902. The number of each kind taken at four of the stations was as follows:

Station.	Sulphur-bottoms.	Common Finbacks	Pollack Whales.	Hump-backs.	Total.
Snook's Arm Station*		79		21	100
Balena Station†	65	31		11	107
Chaleur Station†	60	11		6	77
Rose-au-Rue Station†	5	70	4	9	88
Total	130	191	4	47	372

The fifth station, at Aquaforte, took about 100 whales, mostly humpbacks.

The existence and importance of this fishery are as yet not widely known in the United States. Thus, in the latest number of the *American Museum Journal* (January, 1903, p. 10), in a notice of a probable sulphur-bottom, it is stated that "whalers know this species as the 'finner' or 'finback' (*B. musculus*) and do not prize it, on account of the small amount of blubber and the small size of the whalebone it carries." When it is considered that a sulphur-bottom whale is worth about $1,000 it becomes evident that this statement is hardly warranted.

Frederick W. True.

U. S. National Museum,
January 6, 1903.

* East coast.

† South coast.

A SECOND BISHOP'S RING AROUND THE SUN AND THE RECENT UNUSUAL TWILIGHT GLOWS.

To the Editor of Science: A glare around the sun merging into a faint smoky red or purple ring 5° to 10° wide, with the maximum color about 30° from the sun, has been observed here during the past two weeks. Mr. Rotch noticed a smoky ring around the sun on one day in August but no further unusual glare or color was noticed around the sun

until recently. I first noticed it on the afternoon of December 28 about half an hour before sunset, when it formed a purple ring, or partial ring around the sun, with the maximum color about 30° from the sun. The following note, made on January 9, gives a description as well as I can of the ring as it appears at present.

January 9.—At 9 to 10 A.M. yesterday morning and again at 10 A.M to-day the ring around the sun resembling a faint Bishop's ring was visible. [Bishop's ring was the name given to the ring observed around the sun after the Krakatoa explosion in 1883.] At 10 A.M. a whitish glare surrounded the sun out to about 20°, when it showed a ring of slightly yellow light; outside of this, at a distance of 25° to 30° from the sun, was a ring of faint smoky red or purple light visible out to a distance of about 40° from the sun. From 11 A.M. to 2 P.M. the colors were not visible, but only the whitish glare. At 3 P.M. a faint red or purple again became visible on the outer edge of the glare and grew more distinct as sunset approached. At 4:27 P.M., about two minutes before sunset, the glow seemed to form a broad purple ring about 7° wide and with its maximum intensity about 40° from the sun. At this time, and for several minutes after sunset, the matter causing the glare was visible as whitish striæ within the purple circle, resembling thin cirro-stratus clouds or cirrus haze. The striæ or ripples extended in a north and south direction. [Observations with a nephoscope on the two succeeding days showed that they were moving very slowly from WSW.] Outside this circle of glare around the sun the sky was blue all day without a sign of clouds. After sunset the colored ring became a deeper purple and approached the horizon. At 4:45 P.M. the maximum color was about 25° altitude and there was a fine purple twilight arch in the east. At 4:50 P.M. there was an orange glow on the horizon about 5° wide, as there had been since sunset, and above this was the greenish-yellow ring of striated cloud matter, while above this latter was the outer ring now developed into a bright purple afterglow, extending from about 10° to 25° altitude. At 4:56 the afterglow had partly merged with the glow on the horizon, forming a bright orange glow extending to an altitude of about 13°. After this time the outer edge of the glow gradually approached the horizon, and there was more red in the color. At 5:10 P.M. the glow was about 4° broad and a faint purple tertiary glow was visible with a maximum of brightness at an altitude of about 20°. At 5:15 P.M. this glow was brighter, with a maximum about 15°, while the glow on the horizon was becoming fainter. At 5:20 P.M. the tertiary glow was still visible with a maximum about 10°. After this the color in both glows waned, and all color disappeared from the western horizon about 5:37 P.M.

The sunsets are less brilliant now than they were in November and December, when they reached their greatest brilliancy. On the clearest days during these months the sunset color lasted from an hour and twenty to an hour and thirty minutes after sunset. The maximum brightness and duration was somewhere near the first of December. The succession of colors in the sunsets on clear days has been as follows: (1) An orange glow on the horizon immediately following sunset, lasting twenty to thirty minutes; (2) a purple arch which appeared a few minutes after sunset high up in the sky, with its maximum brightness 30° to 45° above the horizon. As this glow approached the horizon it increased very much in brightness and became more red, usually reaching its maximum brightness about 25 minutes after sunset at an altitude of 10° to 15°, but sometimes continuing to increase in brightness until it reached the horizon, about 35 minutes after sunset; (3) a second faint purple glow which appeared about 40 minutes after sunset between 20° and 50° altitude, and reached the maximum brightness about 50 to 55 minutes after sunset at an altitude between 10° and 20°.

The following note made on December 6, 1902, is typical of the observed changes.

December 6.—4:12 P.M., sunset; 4:20 P.M., orange glow on horizon, faint purple glow over most of the western sky down to about 15° of the horizon; 4:25 P.M., bright yellow-red,

or orange, on horizon, purple glow getting somewhat brighter; 4:30 P.M., orange glow continues on horizon, the afterglow has changed from purple to pink and is much more brilliant, extending to within 7° of the horizon, maximum brilliancy about 15° altitude; 4:35 P.M., the orange glow continues on the horizon, maximum brightness of the afterglow about 10°; 4:40 P.M., orange glow on horizon growing fainter, the maximum brightness of the secondary glow is at an altitude of 7° and is growing somewhat fainter; 4:45 P.M., primary joined to secondary glow and forms a bright orange band about 6° wide on horizon; 4:50 P.M., bright red band about 3° wide on horizon, with here and there short streams extending toward zenith, a faint purple tertiary glow has appeared at an altitude of about 45°; 4:55 P.M., red glow about 2° wide on horizon, tertiary glow brighter and extending from altitude 20° to zenith, maximum about 40°; 5:00 P.M., tertiary glow bright, with maximum about 20°; 5:05 P.M., red glow on horizon fading, purple tertiary glow still bright, with maximum about 15°; 5:10 P.M., tertiary glow fading, maximum about 10°; 5:10 P.M., reddish glow about 5° wide on horizon lasting until 5:25 P.M., when it began to fade rapidly; 5:30 P.M., red band on horizon about 1° broad and growing faint; 5:35 P.M., reddish glow still visible; 5:40 P.M., glow gone.

The duration of these sunsets was considerably longer than the normal sunsets, and it is probable that they were due to the dust from the West Indian volcanoes.

Henry Helm Clayton.

Blue Hill Meteorological Observatory.
January 11, 1903.

SHORTER ARTICLES.

SOME CORROSIONS FOUND ON ANCIENT BRONZES.

At the suggestion of Gen. C. G. Loring, of the Boston Museum of Fine Arts, I undertook, some years ago, the investigation of various corrosions appearing on ancient bronzes. The large collection of Grecian and Egyptian bronzes in the Boston Museum furnishes sufficient variety to make the observations of general value. The results obtained may, therefore, be of interest to collectors and curators of other museums.

The ordinary dark green corrosion or *patina* familiar to every one, and most commonly observed on bronze statues exposed to the weather, consists of basic copper carbonate and is comparatively harmless. On very old statues, especially if they have been buried, two different corrosions have been noticed, which from their appearance may be designated as the *pale blue* and *pale green* excrescences. As will be seen later, both may endanger the life of the bronze, and especially the pale blue is the seat of an active chemical reaction.

The *pale blue* excrescence occurs in blotches all over the surface of the bronze and is especially noticeable in less exposed parts, such as indentations or cavities. It has a very fine powdery appearance and, on account of the ease with which it seems to spread from one bronze to the other, was supposed to be of bacterial origin.* A chemical analysis, however, indicates a different origin of the corrosion. About a gram of the substance was carefully collected and found to consist of 50 per cent. sodium carbonate, 25 per cent. copper carbonate, 25 per cent. sand and a trace of sodium stannate. The large percentage of sodium carbonate leads to the following theory as to the origin of the blue rust: As long as the bronze lay buried in the dry Egyptian soil, no reaction took place; on exposure to a moist atmosphere, however, some moisture condensing gave the carbonic acid of the air a chance to combine with the sodium carbonate, forming acid sodium carbonate. This then attacks the metal, forming copper carbonate and regenerating the sodium carbonate, which combines with the copper carbonate to form a double salt, thus accounting for the blue color. It is easy to see how in the course of time a large amount of metal may be thus corroded. To test the above hypothesis a fresh piece of bronze and some powdered sodium carbonate were exposed for several months to a warm, moist atmosphere. The pale blue excrescence appeared and was identical in all respects with the original rust col-

* Dr. Wm. Frazer, *Nature*, 1898, May 19.

lected from the statuettes. The pale blue rust can be best removed as follows: The statuette is immersed in a bath of hot water and live steam passed in for one hour to keep the temperature up to 100° C. The sodium carbonate is thus completely dissolved, the blue color changing to black as the sodium carbonate goes into solution. Careful brushing from time to time facilitates the process. After about one hour's treatment the metal is exposed and the rust completely removed. The dark green patina is not at all altered by this treatment. Any loosely adhering fragments of stucco can easily be preserved by exercising a little ordinary care.

The *pale green* excrescence resembles the pale blue in almost every particular except the color. It occurs in patches or layers sometimes several millimeters in thickness, and can be distinguished from ordinary patina by its lighter color and more powdery appearance. On chemical analysis it was found to contain no sodium carbonate and to consist mainly of copper carbonate. The removal of the pale green corrosion is much more difficult and liable to damage the statuette. With care, however, the following method gives good results: The bronze is immersed in a hot solution of five per cent. caustic soda for several minutes. The green color immediately turns to blue and the rust is loosened sufficiently to be removed with a dull instrument. Alternate treatment with the alkali and mechanical scraping will finally remove all of the corrosion. All of the alkali must now be removed by careful rinsing, and if necessary with a very dilute solution of hydrochloric acid. The dark green patina is also removed by this process and an ancient statue may acquire an undesirable appearance of newness.

The desirability of cleansing the bronzes at all must also be considered. In the case of the pale blue corrosion this seems necessary, as considerable quantities of metal can be destroyed by the action of the sodium carbonate. In the case of the pale green the destruction of the metal does not take place as rapidly, and other factors must be considered. If the bronze is to be used as a show specimen it is better to leave it unchanged in its antique appearance. For purposes of study, however, a complete cleansing of the surface is necessary, as tracings and engravings have often been exposed which otherwise might not have been revealed. After cleansing the statues should be kept as much as possible in a dry atmosphere. Statuettes in the Boston Museum cleansed by the above methods and placed in air-tight cases have not again become corroded. Some implements are made of very thin metal, and the removal of the thick layer of corrosion would leave too thin a shell. Such cases must be individually considered, and it is better not to place the responsibility of cleansing valuable bronzes in unreliable hands.

WALDEMAR KOCH.

CHICAGO, ILL., September, 1902.

NOTE ON THE CIRCULAR SWIMMING OF SAND-DOLLAR SPERMATOZOA.

WHILE studying artificial parthenogenesis in the sand-dollar (*Echinarachnius parma*) during the past summer, the writer independently observed that when the spermatozoa of this species are placed in a drop of seawater on a slide they nearly or quite all gather at the upper and under surfaces of the drop and move there in circles. As seen from above, those at the upper surface move in a clockwise direction, and those at the under surface in a counter-clockwise direction. That is, since the head of the spermatozoon is directed towards the surface of the water, considered from its position the motion is always counter-clockwise.

This motion is so common as to seem at times to be universal, and it occurs without regard to the presence or absence of a cover-glass above the drop. The circle is approximately constant in size, having a diameter of about the length of the spermatozoon.

This attraction of the spermatozoon to the surface of the drop apparently shows it to be strongly stereotropic. Two possibilities suggest themselves as explanations of the circular motion. One is that the spermatozoon is differentiated in two planes, so that it has what may be called dorsal, ventral, right and left

sides. We may then say that the dorsal side of the spermatozoon is always directed toward the surface of the drop and that its body is bent or curved toward the left. The second possibility is that the condition here is the same as that described in certain insects by Ballowitz,* who considers the circular motion as a modification of the normal spiral motion which these spermatozoa have when in the middle of the fluid. Being at the surface, further progress in that direction is impossible.

Besides the above-mentioned article by Ballowitz, Dewitz † has described circular motion in the spermatozoa of *Periplaneta orientalis* and other insects, and Dungern ‡ and Buller § have found this phenomenon in all classes of the Echinodermata. Buller's paper, dealing with this subject in some detail and including a study of closely allied species, makes any further account of my observations an unnecessary repetition. It is to be hoped, however, that more careful studies on the structure of the Echinoderm spermatozoon will throw some light on the cause of this interesting phenomenon if, as seems probable, it be structural. G. M. Winslow.

Lasell Seminary, Auburndale, Mass.,
December 23, 1902.

NOTES ON ENTOMOLOGY.

The question of the interpretation of the mouth parts of Diptera has long been a bone of contention among entomologists. Mr. Walter Wesche in a recent article|| has furnished some additional light on the subject. The author found, by examining the cibarian structure of various flies, that in a few forms there are distinct, though small, projections arising from the proboscis near the base of the hypopharynx. He considers them as 'rudiments' (vestiges) of palpi. They are quite prominent in species of *Hyetodesia, Spilogaster* and *Hydrotea;* and more or less distinct in many Anthomyidæ, Sarcophagidæ, Borboridæ and Sepsidæ, and even in the common house-fly. The position of these palpi indicates, according to the author, that they are maxillary. Therefore, the large palpi of Diptera are labial, and the proboscis is not formed by the union of the labial palpi. The author appears to be ignorant of Dr. Smith's work on the same subject, in which he records two pairs of palpi in the Tabanidæ. Both authors, however, agree that the proboscis is not part of the labium.

* *Zeitschr. f. wissen. Zool.*, Bd. L., 1890, p. 393.

† *Arch. f. die gesammte Physiologie*, Bd. XXXVIII., 1886, p. 358.

‡ *Centralbl. fur Physiologie*, Bd. XV., April, 1901, Heft 1.

§ *Quart. Jour. Mic. Sci.*, Vol. 46, Pt. I.

|| 'Undescribed Palpi on the Proboscis of some Dipterous Flies, with Remarks on the Mouth Parts of Several Families,' *Trans. Roy. Micr. Soc.*, August, 1902, pp. 412–416, 2 pls.

The third volume of Mr. Tutt's 'British Lepidoptera' has been issued.* It is a volume of nearly 600 pages, much of it in fine print. Like the other volumes, its most remarkable feature is the labyrinthine wealth of technical detail. All that has ever been published on British Lepidoptera has been carefully studied, and everything that could be of the slightest interest is reproduced here. This third volume treats of but thirteen species, several species occupying over twenty-five pages, and one, *Lasiocampa quercus,* more than sixty pages. Although the work deals with British insects, the amount of matter on biological subjects is so great that the book can but be of immense interest to all concerned in the study of Lepidoptera.

Professor R. Blanchard has given an interesting review† of the poisonous punctures of certain Hemiptera. He records the finding of an Anthocorid, *Lycotocoris campestris,* in a bed in Liverpool, and a large Reduviid, *Rhodnius prolixus,* that at times attacks man in the United States of Colombia. The latter is known locally as the 'Bichuque.' He summarizes what has been written on the 'kissing bugs' of the United States, and adds some European cases of the punctures of *Reduvius personatus.*

Articles on mosquitoes are now quite the

* 'A Natural History of the British Lepidoptera,' Vol. III., London, July, 1902.

† 'Sur la piqûre de quelques Hémiptères,' *Archives de Parasitologie*, V. (1902), pp. 139–148.

thing. Among many recent ones may be mentioned one by Henri Polaillon.* There are chapters on morphology, anatomy, biology, classification and descriptions of French species, malaria, filariasis, yellow fever and prophylaxis. The author has done a considerable amount of work, especially on internal anatomy, but (as a rule) it simply confirms previous statements.

The specialist who cannot resurrect some long-forgotten name from the mouldy tomes of science to replace a well-known and established name is indeed behind the times. The craze to place our nomenclature on a stable basis is resulting in discoveries comparable only to those made in recent archeology. With the coming of each new periodical from Europe we wonder what old friend is now lost in the bog of synonymy. Walsingham in Microlepidoptera, Kirkaldy in Hemiptera, Oudemans in Acarina, Cambridge in Araneida, and Cockerell in the Coccidæ have been tossing genera hither and thither in a most dazzling fashion. Now Krauss investigates the Orthoptera,† finding (as La Porte and Westwood knew) that even the name of the order falls, a synonym of the older Dermaptera. Among other changes, the old family Acridiidæ becomes Locustidæ; *Locusta* Linn. replacing *Acridium* Latr.; while *Acrida* Linn. dethrones *Truxalis* Fabr., and *Acrydium* Fabr. supplants *Tetrix* Latr. The old family Locustidæ becomes Tettigoniidæ; and *Acheta*, replacing *Gryllus*, turns the family Gryllidæ into Achetidæ. The great pity with all of this reforming is that so much of it is correct.

In Part II. of a new publication‡ Dr. Franz Stuhlmann has an article on the tsetse fly (*Glossina morsitans*) and its connection with the 'Surrah' disease of Africa. This

* 'Contribution a l'histoire naturelle et médicale des Moustiques,' Paris, 1901, pp. 128, 22 figs.

† 'Die Namen der ältesten Dermapteren (Orthopteren) Gattungen und ihre Verwendung für Familien- und Unterfamilien-Benennungen auf Grund der jetzigen Nomenclaturregeln,' *Zool. Anzeiger*, 1902, pp. 530–543.

‡ Bericht über Land- und Forstwirtschaft in Deutsch-Ostafrika,' Bd. I., heft 2 (1902).

disease, which is fatal to many domestic animals, is known in South Africa to be transmitted by the tsetse fly. The life-history of the parasite is not yet known, but it is supposed to pass certain stages within the fly. The tsetse fly, as Stuhlmann states, is closely related to the common stable fly (*Stomoxys calcitrans*), and he gives the life history of the latter insect as probably being similar to that of the tsetse fly. The author compares the various species of *Glossina*, and records finding *G. tabaniformis* in East Africa. He suggests the various lines of investigation that should be followed to discover means of fighting the disease.

The government of India has published a paper on forest insects by Professor E. P. Stebbing, Forest Entomologist of India.* It is illustrated by six plates drawn by a native artist. Fifty-two species are treated; a description, life history, nature of damage, and suggestions for control. Most of the injurious species are Lepidoptera, and among them we note *Agrotis ypsilon* and a number of forms closely allied to the gypsy moth. Three species of Coccidæ of the genus *Monophlebus* are new.

The second part of Kertész's catalogue of the Diptera of the world has been issued. It treats of the families Cecidomyiidæ, Limnobiidæ, Tipulidæ and Cylindrotomidæ. There is also a list of the Cecidomyiidæ according to the plants that serve the larvæ as food. He uses *Cecidomyia* for the species previously called *Diplosis*.

Yellow Entomology.—The popularization of science has gone a long way, but Mr. Harvey Sutherland in the 'Book of Bugs'† has carried it beyond all previous records. The book treats of the insects most common about the house and yard. It is replete with many interesting actual facts, and contains few serious misstatements (such as *Vedalia* eating San José scale). But all these facts are so thickly sugar-coated with humor and nonsense that it will be difficult for the lay

* 'Departmental Notes on Insects that affect Forestry,' No. 1, pp. 149, Calcutta, 1902.

† 'The Book of Bugs,' New York and London, 1902, pp. 223, 41 figs.

mind to distinguish fact from fancy. Since much of it evidently is not so, the tendency of the average reader will be either to disbelieve everything that seems improbable, or else with child-like faith to swallow both Jonah and the whale. That the facts of nature should be presented in a pleasant and attractive form will be admitted by all, but for this purpose it is not necessary to adopt the style of the comic weekly. It tends to discredit the facts. The author has been very careful in his selection of matter, but his treatment will not, we think, develop a popular interest in insects.

Nathan Banks.

BOTANICAL NOTES.

PHARMACOGNOSY.

In this department of botany, which is scarcely entered by professional botanists in America, there should be found opportunity, as in Europe, for that critical study of cells and tissues which so delights a certain class of students. We have sometimes felt that professors in German universities were to be envied because of the easy way they have of putting a dull student at work on some root or bark, expecting no more from him than a year or two of patient sectioning, drawing and describing. The work is original, and yet there is no danger that the inexperienced and really incompetent student will attempt to make any generalizations, nor that he will ask his instructor to help him make certain 'conclusions.' We are reminded of all this by a volume entitled 'A Course in Botany and Pharmacognosy; by Professor Kraemer, of the Philadelphia College of Pharmacy, which has just appeared. The book was written 'to meet the individual needs of the author in his work as a teacher of botany and pharmacognosy,' and as such is worthy of serious attention. Any book which is the outcome of a successful teacher's experience is a contribution to the pedagogics of the subject with which it deals, and on that account, if on no other, should be of interest to every teacher or student of that subject. Professor Kraemer's book apparently embodies his solution of a problem in pedagogics, and apparently the problem is how to give the student of drugs enough knowledge of botany to enable him to study dried roots, stems, leaves, etc., with sufficient intelligence to make it worth his while to do the work. We confess to not liking this way of preparing a student for his work by a 'short cut' in botany, but no doubt the author dislikes it too. He faces a 'condition, not a theory' which is quite too common in schools of pharmacy and medicine, in which inadequately prepared men must be given technical instruction when they should be at work on the underlying and antecedent subjects. What can one do with a student in pharmacognosy who has not had a good training in plant histology, and systematic botany? He must give such 'short-cut' training as the time will permit, and then push his half-prepared men into their technical work; and who can affirm that this is not the best solution, under the circumstances?

The book before us devotes one hundred pages to a rapid and rather superficial examination of the cell, the vegetative, and the reproductive parts of the plant, and this is followed by over two hundred pages relating to crude and powdered drugs, a few pages in regard to reagents, and finally the descriptions of the seventeen plates at the end of the volume. Throughout the first part the whole intent appears to be to prepare the student in the shortest possible time to know the application of every term which he is likely to meet in his subsequent work, and to know how to treat the different specimens he has to take up. The student is not made a botanist, by any means; he is put in possession of a lot of empirical information so that he may be able to make some sort of study of drugs. And no doubt as long as the colleges of medicine and pharmacy admit such illy prepared men, this is a wise course to pursue, and this book thus becomes a useful text for such students. The lesson to be derived from it is that botanists should insist that if pharmacognosy be taught at all, the students should have better antecedent preparation, by having taken courses in plant histology and systematic botany. Were this accomplished, pharmacognosy would become a part of scientific bot-

any, and the study might have much greater value to medical and pharmacal students.

AMATEUR SYSTEMATIC BOTANY.

A FEW days ago there came into the writer's hands a pretty little book, 'Fieldbook of American Wild Flowers,' by F. S. Mathews (Putnam's Sons), which is so suggestive and helpful as to appear worthy of some notice here. Its title is misleading, since the book is by no means 'American' in its scope, its range being confined to what we are calling 'northeast North America,' that is, practically the region covered by Gray's 'Manual.' This should be corrected in subsequent editions, or we may have anxious amateurs in Georgia, Texas, Wyoming, Montana and Arizona trying to fit western plants to eastern names and descriptions. It is not right that the title should be so much larger than the work itself. It is a fieldbook for a restricted portion of the country, and this should be clearly stated.

The book includes species of seventy-two families of flowering plants, the word 'flowering' being interpreted popularly, so that grasses, sedges, willows, oaks, elms, etc., are omitted as not having showy flowers. The arrangement of the families is that of Engler and Prantl. The species are described quite non-technically, and this work is so well done that the book should enable any one to identify every plant included in its pages. The many excellent plates, many of which are colored, will greatly help the beginner. The book is worthy of many editions, and no doubt will stimulate many a person to know more about the common wild flowers.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

RECENT ZOOPALEONTOLOGY.

THE COPE PAMPEAN COLLECTION.

THIS collection, representing the Pleistocene fauna of South America, includes three series of specimens, brought together by Ameghino, Larroque and Brachet, and sent by the Argentine Republic to the Paris Exposition of 1878. Professor Cope was so captivated by this collection that he purchased it outright, and brought it to this country. For more than twenty years it remained packed away out of sight in the cellar of Memorial Hall in Fairmount Park, Philadelphia. The American Museum of Natural History has acquired the collection from the executor of the Cope estate through funds subscribed by six of its trustees, Messrs. H. O. Havemeyer, William E. Dodge, D. Willis James, Adrian Iselin, Henry F. Osborn and the late James M. Constable.

It includes a very full representation of the Pleistocene fauna of South America, among which are a considerable number of type and figured specimens, all, with one exception, described or figured by Florentino Ameghino. The gem of the collection, now being mounted for immediate exhibition, is the skeleton of a very large specimen of the saber-toothed tiger belonging to the genus *Smilodon;* it lacks only the fore feet, which have been supplied from casts taken from the skeleton in the Museum of Buenos Aires.

The following specimens are especially noteworthy. Among the smaller Carnivora the type skeleton of *Conepatus mercedensis,* finely preserved, consisting of skull, jaws, limbs and about half the vertebræ. Among the rodents is *Lagostomus,* including various skulls and skeletons, which may be combined for a complete mount. The Litopterna are represented by the jaws and upper teeth of *Macrauchenia.* Of the Toxodonts, there are a skull and jaws, and separate limb and foot bones. The Proboscidea are represented by the fore and hind limbs and tusk of the Pampean mastodon. Among the Edentates are the following: Armadillos—*Eutatus brevis,* type skeleton in fair condition; *Dasypus,* skull, jaws, and a third of the carapace and skeleton; Glyptodonts—*Panochthus frenzelianus,* type skeleton lacking the vertebræ and teeth, but including the carapace casque; the skull, jaws, casque and carapace of two other specimens of *Panochthus;* skull, jaws and limbs of other specimens; *Dœdicurus,* carapace; *Hoplophorus,* a fairly complete skeleton, except some vertebræ, with carapace, casque and tail-shield included. Among the ground-sloths there is a nearly

complete skeleton of *Lestodon armatus*, which can be mounted for exhibition, a large animal approaching the megatherium in size; *Lestodon myloides* is represented by a nearly complete skeleton which can be mounted, also by two skeletons of young animals; there is also a nearly complete skeleton of *Mylodon robustus*, which can be mounted by filling out the vertebral column with vertebræ of other individuals; this species is also represented by several incomplete skeletons and skulls; *Scelidotherium* is represented by two fine skulls, with a third of a skeleton, also by two inferior skulls with the greater part of the skeleton, but hardly sufficient to mount.

Work upon the preparation of this collection has already begun, and it will be pushed forward as rapidly as possible. It will be arranged partly zoologically and partly faunistically, in connection with the Patagonian collection made by Mr. Barnum Brown three years ago, which is now almost completely worked out for exhibition. The Patagonian types are largely ancestral to those of the Pampean, and while the latter contain an admixture of the northern forms, the faunal arrangement of these successive series so strikingly characteristic of South America will be of very great interest. H. F. O.

SCIENTIFIC NOTES AND NEWS.

Professor F. W. Clarke, of the U. S. Geological Survey, has been invited to deliver the Wilde lecture before the Manchester Literary and Philosophical Society next year on the occasion of the celebration of the hundredth anniversary of the propounding of the atomic theory at Manchester by Dalton. Professor Clarke will at the same time be given the Wilde gold medal of the society.

Dr. W. L. Bryan, president of Indiana University, has been elected president of the American Psychological Association.

The King of Denmark has conferred an order of knighthood on Lord Lister.

A marble bust of Sir William Muir, until recently principal of the University of Edinburgh, was unveiled on December 19. Sir William Turner received the bust on behalf of the university.

Professor H. V. Hilprecht, of the University of Pennsylvania, lectured on January 16 before the Anthropological Society at Berlin on his excavations at Nippur. He expects to return to America shortly, and will then leave on a further expedition.

Dr. Alfred Emerson, formerly professor of classical archeology at Cornell, has returned from a five years' absence in Europe and Asia Minor. He has recently been collecting antiquities for the Hearst collection at the University of California.

At the recent meeting of the Iowa Park and Forestry Association at Des Moines, Professor Macbride, of the State University of Iowa, gave the president's address. At a joint meeting of the Park Association and the Iowa Horticultural Society, Professor Shimek read a paper on the Iowa oaks. Professor Macbride was reelected president of the association.

Mr. John Hyde, statistician of the Department of Agriculture, has been awarded damages to the amount of $2,500 by the New Orleans courts against a firm of cotton brokers, which in December, 1901, caused a cable dispatch to be sent to Liverpool, England, to the effect that the United States Government cotton report was incorrect and unreliable, and intimating that the report was in the interest of speculators.

The *Alumni Register* of the University of Pennsylvania announces that Dr. Simon Flexner, professor of pathology, has received a grant from the Carnegie Institution, and that his assistant, Dr. Noguchi, has been appointed the first research assistant. It is reported in the daily papers that the Lick Observatory has received from the institution a grant of $4,000.

The Manchester Literary and Philosophical Society has awarded its Dalton medal to Professor Osborne Reynolds, F.R.S.

Professor Schwendener, of Berlin, has been elected president of the German Botanical Society and Professor von Wettstein, of Vienna, vice-president.

The Academy of Sciences of Göttingen has elected as corresponding members Professors Bezold (physics) and von Richthofen (geog-

raphy), of Berlin; Pfeffer (botany), of Leipzig, and Tschermak (mineralogy), of Vienna.

DR. WILHELM FÖRSTER, professor of astronomy at the University of Berlin, and director of the observatory, celebrated his seventieth birthday on December 16.

THE council of the Geological Society of London has made the following awards for the present year: The Wollaston medal to Professor Rosenbusch, of Heidelberg, the eminent petrologist; the Murchison medal to Dr. Charles Callaway, who has done much good work on the older rocks of Britain; the Lyell medal to Mr. F. W. Rudler, who recently retired from the post of librarian and curator of the Museum of Practical Geology, in which he gave untiring assistance to the many who sought his advice; the Prestwich medal, of which the award is made this year for the first time, to the fellow-worker and friend of Prestwich, Lord Avebury; the Bigsby medal to Dr. H. M. Ami, of the Canadian Geological Survey. The balance of the Wollaston fund has been awarded to Mr. L. L. Belinfante, the assistant secretary of the society, in recognition of his valuable services. The Murchison fund is allotted to Mrs. Robert Gray, of Edinburgh, whose collection of Girvan fossils, described by H. A. Nicholson and R. Etheridge, Jr., has been of great service to many geologists. The Lyell fund is divided between Mr. S. S. Buckman, whose work on the paleontology and stratigraphy of the lower oolitic rocks is so well known, and Mr. G. E. Dibley, who has done valuable work in collecting fossils and working out their zonal distribution in the chalk of Kent.

THE board of trade has appointed Professor Wyndham Dunstan, F.R.S. (now director of the Scientific and Technical Department of the Institute), to be director of the Imperial Institute at South Kensington. Professor Dunstan will continue in charge of the scientific investigation of economic products, and will supervise any other branches of work carried on by the Board of Trade in the building at South Kensington, including the collection of products of the empire so far as they will be under the control of the board.

JOHN B. HENCK, formerly professor of civil engineering in the Massachusetts Institute of Technology, died in California on January 3 at the age of eighty-seven years.

DR. BUSHROD WASHINGTON JAMES, the Philadelphia oculist and homeopathic physician, author of books on Alaska and other scientific topics, died on January 6, aged sixty-seven years.

MR. JOHN NATHANIEL CLARK, known for his work in ornithology, died at Old Saybrook, Conn., on January 14, at the age of seventy-two years.

THE death is announced of Dr. Henry Edward Schunck, near Manchester, on January 13, at the age of eighty-two years. He retired from business at an early date, and devoted himself to the study of chemistry, publishing important papers on organic coloring matters. He was fellow of the Royal Society, and had been president of the Manchester Literary and Philosophical Society and of the Society of Chemical Industry.

WE regret also to record the deaths of Professor Leonard Landois, professor of physiology at the University of Greifswald, and of M. Goubet, the inventor of the submarine torpedo boat bearing his name.

MR. CARNEGIE has intimated to the provost of Greenock that he is prepared to present to a properly authorized authority in the town the sum of $50,000 to defray the cost of the erection of a memorial to James Watt.

THE annual meeting of the board of regents of the Smithsonian Institution will be held at Washington on January 28.

AT the annual meeting of the managers of the New York Botanical Garden, two research scholarships were established. It was announced that forty-three investigators had availed themselves of the privileges of the garden during the past year. About 67,000 specimens have been received by the museum and herbarium and about 90,000 specimens have been added to the collection.

AT a meeting of the New York Zoological Society on January 13, it was announced that seven hundred thousand people had visited

the park last year. The aquarium, which is now controlled by the society, is visited daily by fully five thousand persons.

The French government has established a bacteriological institute at Bangkok, Siam.

The coast survey steamer *Bache,* which was lately fitted out for service on the coast of Porto Rico, will make surveys for charts and maps of the coast of the island.

The young women doing research work at the University of Michigan have organized the Women's Research Club of the University of Michigan. The officers are: president, Lydia M. DeWitt, B.S., M.D., who is doing work in histology; vice-president, Maud DeWitt, B.S., zoological department; secretary, Ellen B. Bach, A.B., botanical department; and treasurer, Frances Dunbar, zoological department.

The Friday evening meetings of the Royal Institution of Great Britain will be resumed on January 16, when Professor Dewar will give an address on 'Low temperature investigations'; on January 23, Dr. Tempest Anderson will speak on 'Recent volcanic eruptions'; on February 13, Professor Sheridan Delépine will give a lecture on 'Health dangers in food'; on February 27, Dr. Adolf Leibmann will speak on 'Perfumes, natural and artificial'; on March 6, Professor J. G. McKendrick on 'Studies in experimental phonetics'; on March 13, Professor Karl Pearson on 'Character reading from external signs'; and on March 20, Professor Schäfer on the 'Paths of volition.'

UNIVERSITY AND EDUCATIONAL NEWS.

During the last few weeks, Cornell College, Iowa, has added $71,500 to its endowment funds. A friend whose name is not yet made public gave $50,000. Mr. Fred W. Brown, of Belle Plain, Iowa, has given $10,000. Work on the Carnegie library will be begun early in the spring, as $40,000 of the endowment necessary for its maintenance has been secured and only $10,000 more is necessary. There are upwards of 600 students in the institution.

The exercises at the installation of William Lowe Bryan, Ph.D., as president of Indiana University are as follows:

JANUARY 20, 2.30 P.M., FOUNDATION DAY EXERCISES, EIGHTY-THIRD ANNIVERSARY OF THE FOUNDING OF THE STATE SEMINARY.

Address on behalf of the trustees: Honorable Benjamin F. Shively; address on behalf of the faculty: Professor Ernest H. Lindley; address on behalf of the alumni: President Joseph Swain, Swarthmore College; addresses on behalf of the State.

8 P.M., RECEPTION TO DELEGATES AND VISITORS.

Welcome to visitors: Professor Gustaf E. Karsten, *Chairman of Committee;* responses by delegates.

JANUARY 21, 9 A.M., DEDICATION OF SCIENCE HALL.

Address by Professor Edward L. Nichols, Cornell University; address by Professor John M. Coulter, University of Chicago; address on behalf of the university, by Professor Arthur L. Foley.

2:30 P.M., INSTALLATION OF THE PRESIDENT.

Address by President W. H. P. Faunce, Brown University; address by President E. Benjamin Andrews, University of Nebraska; installation of President Bryan by Chief Justice Hadley, Indiana Supreme Court; address by President Bryan.

The Treasury has given its assent to the scheme by which Reading Corporation acquires the site and buildings of the University College for the purpose of extending the municipal offices, etc., at a cost of £50,000. The college, in exchange, obtains a much larger site on the London-road, whereon it is intended to erect a handsome pile of college buildings.

Professor Lehmann-Hohenberg has been dismissed from his chair at the University of Kiel for criticizing the courts. We do not know how far this action may have been warranted, but it appears somewhat remarkable that the disciplinary court should state that university professors, being officers of the government, are not permitted to criticize the government.

At Purdue University Mr. L. V. Ludy has been placed temporarily in charge of the department of analytical and applied mechanics and Mr. J. A. Thaler has been appointed instructor in analytical and applied mechanics.

Mr. J. S. MacDonald, assistant lecturer in physiology at University College, Liverpool, has been appointed professor of physiology at University College, Sheffield, in succession to Professor Myers-Ward, who goes to Charing Cross Hospital as lecturer in physiology.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 30, 1903.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*CARNEGIE INSTITUTION OF WASHINGTON.**

MEETING OF INCORPORATORS OF THE CARNEGIE INSTITUTION OF WASHINGTON.

THE meeting of the Incorporators of the Carnegie Institution was held at the office of the Secretary of State, Washington, D. C., January 4, 1902, at 10 o'clock A.M.

Present: Hon. John Hay, Secretary of State, Justice Edward D. White, Dr. Daniel C. Gilman, Dr. John S. Billings, Hon. Carroll D. Wright and Dr. Charles D. Walcott. Mr. Hay was chosen chairman of the meeting and Mr. Walcott secretary.

On receipt of notice of the filing of the Articles of Incorporation, Mr. White moved that the incorporators proceed to ballot for trustees. This was done, and the following persons were unanimously elected:

Ex Officio. The President of the United States; the President of the Senate; the Speaker of the House of Representatives; the Secretary of the Smithsonian Institution; the President of the National Academy of Sciences.

Grover Cleveland, New Jersey; John S. Billings, New York; William N. Frew, Pennsylvania; Lyman J. Gage, Illinois; Daniel C. Gilman, Maryland; John Hay, District of Columbia; Abram S. Hewitt, New Jersey; Henry L. Higginson, Massachusetts; Henry Hitchcock, Missouri; Charles L. Hutchinson, Illinois; William Lindsay, Kentucky; Seth Low, New York; Wayne MacVeagh, Pennsylvania; D. O. Mills, New York; S. Weir Mitchell, Pennsylvania; William W. Morrow, California;

* Abstracts from the Year Book, No. 1, 1902.

Elihu Root, New York; John C. Spooner, Wisconsin; Charles D. Walcott, District of Columbia; Andrew D. White, New York; Edward D. White, Louisiana; Carroll D. Wright, District of Columbia.

FIRST MEETING OF BOARD OF TRUSTEES.

The Trustees assembled in the Diplomatic Room, Department of State, Washington, D. C., Wednesday, January 29, 1902, at half past two. They were called to order by Hon. Abram S. Hewitt, who nominated for temporary chairman Hon. John Hay, who was unanimously elected and took the chair. Mr. Hewitt then nominated Dr. Charles D. Walcott as temporary secretary, and he was unanimously elected.

The secretary then read the minutes of the meeting of the incorporators and presented the Articles of Incorporation, after which Mr. Andrew Carnegie was introduced by the chairman, and made the remarks which have been printed.

The following resolution was presented and unanimously adopted:

"In addition to the personal and individual expressions extended to Mr. Carnegie for what he has done for the world to-day:

"*Resolved*, That the chairman of this meeting be requested to draft a letter addressed to Mr. Carnegie expressing the views of the Trustees concerning this magnificent gift and the purposes for which it is to be applied as set forth in the letter and other documents which have just been read."

Attention was called to the vacancy on the Board caused by the declination of Hon. Grover Cleveland, who had not found it possible to accept a place on the Board on account of his health. The Board balloted for a trustee to fill a vacancy thus arising, and Mr. William E. Dodge, of New York, was unanimously elected.

A proposed code of by-laws was then presented, discussed, amended and adopted.

Election of officers was then held with the following result:

Chairman of the Board of Trustees—Abram S. Hewitt.

Vice-Chairman of the Board of Trustees—John S. Billings.

Secretary of the Board of Trustees—Charles D. Walcott.

President of Carnegie Institution—Daniel C. Gilman.

Relative to the acceptance of the trust created by Mr. Carnegie, it was

Resolved: That the Board of Trustees, acknowledging the generosity of the gift of Mr. Carnegie, in the foundation of the Institution, desire to express the concurrence of the Trustees in the scope and purpose stated in his deed of trust, and hereby formally accept the donation and the responsibilities connected with it.

It was also voted that the resolution just adopted be forwarded to Secretary Hay, to be by him sent to Mr. Carnegie, with a letter expressing the views of the Trustees on the gift. Mr. Hay subsequently transmitted the resolution and with it the following letter:

Department of State,
Washington, *March 7, 1902.*

Hon. Andrew Carnegie,
5 West 51st Street, New York City.

Sir: The Trustees of the Carnegie Institution, which you have recently founded in the city of Washington, formally accepted your gift, by the adoption of the appended Resolution.

At the same time they requested me, as the presiding officer at the first meeting of the Board, to convey to you by a letter an expression of their hearty appreciation of your munificence, and also their admiration of the noble purpose and the liberal spirit which distinguish your foundation.

For the advancement of knowledge and the education of youth, there are already in this country many strong institutions, learned societies, universities, government bureaus, libraries and museums. With all of them the Carnegie Institution can cooperate, while it has a field of its own, carefully indicated in your deed of gift, and more fully explained by the remarks which you addressed to the Board.

Every one of those whom you have chosen as Trustees will regard it as a sacred duty and a pleasure, to uphold the lofty ideal that you have set before them, and to impart to those who come

afterwards the spirit of confidence and enthusiasm with which the work has begun.

I am, Sir,

Very respectfully yours,

JOHN HAY.

Dr. Gilman, the elected President, then addressed the Board, explaining, so far as they were known to him, the circumstances which preceded the incorporation of the Carnegie Institution. His remarks were extemporaneous and intended to acquaint the Board with his attitude and that of the gentlemen with whom, at Mr. Carnegie's request, he had been associated in these arrangements which preceded the meeting of the Board. He expressed his appreciation of the honor conferred upon him by his selection as President of the Institution, and he indicated in broad outlines the probable methods of procedure. At an early day experts in many branches of science will be selected by the executive committee to whom all applications for encouragement and aid will be referred. These experts will be requested to add their own suggestions, and present their recommendations in writing. Meanwhile, the executive committee will gather information in respect to endowments and establishments for promoting science, at home and abroad, in order that this experience may be at the service of the Trustees, and that there may be cooperation, and not conflict, with other institutions in any plans that may be adopted.

After discussing nominations the following named persons were elected members of the executive committee: John S. Billings, Daniel C. Gilman, Abram S. Hewitt, S. Weir Mitchell, Elihu Root, Charles D. Walcott, Carroll D. Wright.

The following resolutions were then considered and adopted:

Resolved: That the Executive Committee is requested to prepare a report upon the work which should be undertaken by the Carnegie Institution in the near future, such report to be submitted to the Board of Trustees at its next meeting, and to be accompanied with estimates for expenditures required.

Resolved: That the Executive Committee, when they shall have formulated plans of the work which should be undertaken by the Carnegie Institution, shall have the same printed and a copy forwarded to each Trustee prior to the annual meeting in November, 1902.

Resolved: That the Executive Committee is requested to consider the question of a proper administration building for the Carnegie Institution, to be located in Washington, including both a proper site and plans for the same.

SECOND MEETING OF THE BOARD OF TRUSTEES.

The meeting was held in Washington, at the New Willard Hotel, on Tuesday, November 25, 1902, at 10 A.M.

The President of the Institution, Mr. Gilman, made a general statement of the work of the executive committee and referred to the report of the committee, which had been printed and distributed to the Trustees in advance of the meeting.

The Secretary made a brief report, referring principally to the financial transactions of the Institution.

Consideration of the executive committee's report was then taken up, and a long discussion followed on the various recommendations made by the committee.

At the second session the Board resumed its discussion of policy and the recommendations of the executive committee, especially the purchasing of a site. As the outcome a motion to postpone till the next annual meeting the decision on the question of site was made and carried.

The Board then considered and adopted the following resolution:

Resolved: That from the available income of the Institution $50,000 is hereby appropriated for administrative expenses, $200,000 for grants for research during the fiscal year 1902—'03, $40,000 for a publication fund, the expenditures to be made under the direction of the Executive Committee, and that $100,000 of the available income

of the Institution be set apart for a reserve fund during the fiscal year 1902–'03.

Amendments to the by-laws were then considered, and the date of the annual meeting was changed from November to the second Tuesday of December, beginning with the year 1903. By-laws were also adopted providing that the fiscal year of the Institution shall be from November first to October thirty-first, inclusive, and that there shall be a finance committee consisting of three members of the Board, to be elected by the Board and to hold office until their successors are elected. The duty of such finance committee shall be to consider and recommend to the Board of Trustees such measures as it may believe will promote the financial interests of the Institution. The Board then proceeded to the choice of the finance committee, and elected Messrs. Gage, Mills and Higginson.

The following minute relative to the death of Mr. Henry Hitchcock was presented by Mr. Higginson and adopted by the Board:

The death of Mr. Henry Hitchcock has deprived this Board of Trustees of a cultured and wise counsellor, a progressive leader, and a valued associate. Mr. Hitchcock stood for all that was noble in manhood and the development of man. His every effort was to serve any cause with which he was connected with all the power and ability he possessed. We tender to the members of his bereaved family sincere sympathy, and place this resolution in our minutes as a permanent recored of our appreciation and esteem.

The Board then proceeded to fill the vacancy caused by the death of Mr. Hitchcock. Mr. Ethan Allen Hitchcock was nominated and unanimously elected.

PROCEEDINGS OF EXECUTIVE COMMITTEE.

Organization.—At its first meeting the committee organized by electing Mr. Gilman chairman and Mr. Walcott secretary. At the same time lots were drawn for the terms of service of members, three to expire with the annual meeting in 1903, two in 1904 and two in 1905. The result of the drawing was as follows:

Terms expiring in December,

1903, Gilman, Mitchell, Wright; 1904, Billings, Walcott; 1905, Hewitt, Root.

Advisory Committees.—As soon as it was organized the executive committee, in compliance with the instructions of the Trustees, began an investigation to determine what work should be entered upon, in the immediate future, by the Institution. Its first step consisted in the appointment of advisory committees. Eighteen such committees were appointed, as follows:

Anthropology: William H. Holmes, Chief, Bureau of American Ethnology, and Head Curator, Department of Anthropology, U. S. National Museum, Washington, D. C., *Chairman;* Franz Boas, Curator, Department of Anthropology, American Museum of Natural History, New York, N. Y.; George A. Dorsey, Field Columbian Museum, Chicago, Ill.

Astronomy: E. C. Pickering, Professor of Astronomy and Director of Harvard Observatory, Cambridge, Mass., *Chairman;* Lewis Boss, Director of Dudley Observatory, Albany, N. Y.; George E. Hale, Director of Yerkes Observatory, Williams Bay, Wis.; S. P. Langley, Secretary Smithsonian Institution, Washington, D. C.; Simon Newcomb, late Superintendent of Nautical Almanac, Washington, D. C.

Bibliography: Herbert Putnam, Librarian of Congress, Washington, D. C., *Chairman;* Cyrus Adler, Librarian, Smithsonian Institution, Washington, D. C.; J. S. Billings, Director New York Public Library, New York, N. Y.

Botany: Frederick V. Coville, Botanist, Department of Agriculture, Washington, D. C., *Chairman;* N. L. Britton, Superintendent, New York Botanical Garden, New York, N. Y.; John M. Macfarlane, Professor of Botany, University of Pennsylvania, Philadelphia, Pa.; Gifford Pinchot, Forester, U. S. Department of Agriculture, Washington, D. C.

Chemistry: Ira Remsen, Professor of Chemistry and President of Johns Hopkins University, Baltimore, Md., *Chairman;* T. W. Richards, Professor of Chemistry, Harvard University, Cambridge, Mass.; Edgar F. Smith, Professor of Chemistry, University of Pennsylvania, Philadelphia, Pa.

Economics: Carroll D. Wright, Commissioner of Labor, Washington, D. C., *Chairman;* Henry W. Farnam, Professor of Political Economy, Yale University, New Haven, Conn.; John B. Clark, Professor of Political Economy, Columbia University, New York, N. Y.

Engineering: R. H. Thurston, Director of Sibley College, Cornell University, Ithaca, N. Y., *Chairman;* William H. Burr, Professor of Civil Engineering, Columbia University, New York, N. Y.; George Gibbs, Consulting Engineer, Baldwin Locomotive Works, Philadelphia, Pa.; George S. Morison, Civil Engineer, 49 Wall Street, New York, N. Y.; Charles P. Steinmetz, Electrician, General Electric Co., Schenectady, N. Y.

Geography: William M. Davis, Professor of Geology, Harvard University, Cambridge, Mass.

Geophysics: [Joint Committee on Geology and Physics.]

Geology: T. C. Chamberlin, Head of Geological Department and Director of Museum, University of Chicago, Chicago, Ill., *Chairman;* Charles R. Van Hise, Professor of Geology, University of Wisconsin, Madison, Wis.; Charles D. Walcott, Director of U. S. Geological Survey, Washington, D. C.

History: J. Franklin Jameson, Head of Department of History, University of Chicago, Chicago, Ill., *Chairman;* Charles Francis Adams, Boston, Mass.; Andrew C. McLaughlin, Professor of American History, University of Michigan, Ann Arbor, Mich.

Mathematics: E. H. Moore, Head Professor of Mathematics, University of Chicago, Chicago, Ill., *Chairman;* Frank Morley, Professor of Mathematics, Johns Hopkins University, Baltimore, Md.; Ormond Stone, Professor of Astronomy and Director of Leander McCormick Observatory, Charlottesville, Va.

Meteorology: Cleveland Abbe, Professor of Meteorology, U. S. Weather Bureau, Washington, D. C.

Paleontology: Henry F. Osborn, DaCosta Professor of Zoology, Columbia University, New York, N. Y., *Chairman;* Henry S. Williams, Professor of Geology, Yale University, New Haven, Conn.

Physics: R. S. Woodward, Dean of School of Pure Science and Professor of Mechanics and Mathematical Physics, Columbia University, New York, N. Y., *Chairman;* Carl Barus, Professor of Physics, Brown University, Providence, R. I.; A. A. Michelson, Head Professor of Physics, University of Chicago, Chicago, Ill.

Physiology (including Toxicology): S. Weir Mitchell, Philadelphia, Pa., *Chairman;* H. P. Bowditch, Professor of Physiology, Harvard Medical School, Cambridge, Mass.; William H. Howell, Dean of Johns Hopkins Medical School, Baltimore, Md.

Psychology: J. Mark Baldwin, Professor of Psychology, Princeton University, Princeton, N. J.

Zoology: Henry F. Osborn, DaCosta Professor of Zoology, Columbia University, New York, N. Y., *Chairman;* Alex. Agassiz, Curator Natural History Museum, Cambridge, Mass.; W. K. Brooks, Professor of Zoology, Johns Hopkins University, Baltimore, Md.; C. Hart Merriam, Chief U. S. Biological Survey, Washington, D. C.; E. B. Wilson, Professor of Zoology, Columbia University, New York, N. Y.

These advisers were requested to give the committee their views on various important suggestions received by the Institution, as well as independent recommendations originating in the committees. The following is a copy of the letter appointing the advisers and inviting suggestions and recommendations:

MARCH 11, 1902.

DEAR SIR:

The Executive Committee of the Carnegie Institution have been requested by the Trustees to prepare, in the course of the Summer, a plan of procedure, and in the meantime to engage in preliminary studies of the problems committed to them, by consultation with acknowledged authorities at home and abroad.

The plan of the Institution includes the appointment from time to time of counsellors, or advisers, to whom the Committee may refer important suggestions, and from whom they may receive independent recommendations. You are invited to act as one of these advisers until the annual meeting of the Trustees, in November next. It is the purpose of the Institution to provide liberally for any expense that may be incurred in clerical service and in travel by those whom they may consult. If it is agreeable to you to accept this invitation, a more personal communication will be addressed to you at an early day. An immediate answer is requested.

Respectfully,

D. C. GILMAN,
President.

The reports received from the advisory committees, as far as they relate to scope and plan are printed in Appendix A.

A circular letter was also prepared and sent to nearly a thousand scientific men and investigators of prominence, mainly in the United States. This was accompanied by a pamphlet that included the articles of incorporation, the founder's address, and a list of the officers. The circular letter is as follows:

Letter to the Heads of American Institutions and to Others Interested in the Work of Investigation.

The Carnegie Institution sends to you herewith a copy of Mr. Carnegie's deed of gift and other information in respect to the organization of the new foundation.

Some of the ablest thinkers and investigators in the country have already called attention to important lines of inquiry. Their communications will be referred to special committees in different departments of knowledge—astronomical, physical, chemical, biological, geological, archæological, philological, historical, bibliographical, economical, etc.—and the referees will be requested to add their own suggestions and to report to the Carnegie Institution such methods of procedure and the names of such investigators as they deem likely to advance with wisdom the great purpose of the foundation.

No large appropriations can be made at present, as there will be no income from the fund before August. The summer will be chiefly devoted to a careful study of the problems of scientific investigation, at home and abroad, and in the autumn definite plans of procedure will be formulated.

Any member of the Executive Committee will be glad to receive from you at any time suggestions, opinions, and advice as to fields that the Carnegie Institution ought to occupy and the best methods for carrying forward its work in those fields; but in order that important papers designed for official consideration may be properly recorded and filed, they should be addressed to the President of the Carnegie Institution, 1439 K street, Washington, D. C.

Daniel C. Gilman, *Chairman*,
Charles D. Walcott, *Secretary*,
John S. Billings,
Abram S. Hewitt,
S. Weir Mitchell,
Elihu Root,
Carroll D. Wright,
March, 1902. *Executive Committee.*

For its guidance, the committee has formulated and adopted the following statements as to its purposes, principles, organization and policy:

Purposes.—In connection with the determination of the policy of the Institution, it is necessary to clearly define its purposes and to adopt some general plan for organization and administration. The purposes are declared by the founder to be

"To found in the city of Washington an institution which, with the cooperation of institutions now or hereafter established, there or elsewhere, shall in the broadest and most liberal manner encourage investigation, research and discovery—show the application of knowledge to the improvement of mankind, provide such buildings, laboratories, books and apparatus as may be needed, and afford instruction of an advanced character to students properly qualified to profit thereby."

And he adds:

"That his chief purpose is to secure, if possible, for the United States of America leadership in the domain of discovery and the utilization of new forces for the benefit of man."

The trust deed enumerates several aims, all of which may be grouped under two heads, viz:

(A) To promote original research.

(B) To increase facilities for higher education.

Under (A) may be grouped:

(*a*) The promotion of original research 'as one of the most important of all subjects.'

(*b*) To discover the exceptional man * * * and enable him to make the work for which he seems specially designed his life work.

(*c*) The prompt publication and distribution of the results of scientific investigation.

Under (B) may be grouped:

(*a* and *b*) The increase of facilities for higher education by increasing the efficiency of the universities and other institutions, either by utilizing and adding to their existing facilities or by aid-

ing teachers in various institutions in experimental and other work.

(*c*) To enable such students as may find Washington the best point for their special studies to take advantage of the facilities there for higher education and research.

Principles.—It is the judgment of the executive committee that the aims enumerated can be best carried into effect under the following principles, which are to be departed from only in very exceptional cases.

The Institution proposes to undertake—

(A) To promote original research by systematically sustaining—

(*a*) Projects of broad scope that may lead to the discovery and utilization of new forces for the benefit of man, pursuing each with the greatest possible thoroughness.

(*b*) Projects of minor scope that may fill in gaps in knowledge of particular things or restricted fields of research.

(*c*) Administration of a definite or stated research under a single direction by competent individuals.

(*d*) Appointment of Research Assistants.

(B) To increase facilities for higher education by promoting—

(*a*) Original research in universities and institutions of learning by such means as may be practicable and advisable.

(*b*) The use by advanced students of the opportunities offered for special study and research by the Government bureaus in Washington.

The Institution does not propose to undertake—

(*a*) To do anything that is being well done by other agencies.

(*b*) To do that which can be better done by other agencies.

(*c*) To enter the field of existing organizations that are properly equipped or are likely to be so equipped.

(*d*) To give aid to individuals or other organizations in order to relieve them of financial responsibilities which they are able to carry, or in order that they may divert funds to other purposes.

(*e*) To enter the field of applied science except in unusual cases.

(*f*) To purchase land or erect buildings for any organization.

(*g*) To aid institutions when it is practicable to accomplish the same result by aiding individuals who may or may not be connected with institutions.

(*h*) To provide for a general or liberal course of education.

Organization.—The executive committee, keenly realizing the importance of thoroughly investigating and fully considering every proposed action before recommending it to the Trustees, have given much time and thought to the subject of organization, and at the several meetings have discussed the suggestions received from individuals and from the advisory committees. It is hoped and expected that the Institution will set a high standard for research. This the committee believes can be best attained and maintained by establishing such laboratories and facilities, not found elsewhere, as are necessary when dealing with problems.

The committee is of the opinion that organization in Washington should be provided for by—

(*a*) Purchasing in the northwestern suburb of the city a tract of ground suitable for present and future needs.

(*b*) Erecting thereon a central administration building, to serve as the administrative headquarters of research work conducted, directed, or aided by the Carnegie Institution.

(*c*) Establishing such laboratories from time to time as may be deemed advisable.

(*d*) Employing the best qualified men that can be secured for carrying on such research work as it may be decided to undertake in Washington.

(*e*) Continuing and developing the present office organization as the Executive Committee may find it necessary to do in order to properly conduct the work of the Institution.

The only organization outside of Washington to be provided for at present should be such advisers and advisory committees as may from time to time be found necessary in connection with the development of the research work of the Institution.

It is the opinion of the committee that such persons and committees should be largely advisory and not executive in their function. Executive work should be in charge of paid employees of the Institution. These may be officers, research associates and special employees.

Policy.—Soon after the executive committee began its investigations it became evident that two lines of policy were open, namely:

(*a*) To sustain broad researches and extended explorations that will greatly add to knowledge.

(*b*) To make small grants.

Research may be defined as original investigation in any field, whether in science, literature or art. Its limits coincide with the limits of the knowable. In the field of research the function of the Institution should be organization, the substitution of organized for unorganized effort wherever such combination of effort promises the best results; and the prevention, as far as possible, of needless duplication of work. Hitherto, with few exceptions, research has been a matter of individual enterprise, each worker taking up the special problem which chance or taste led him to and treating it in his own way. No investigator, working single handed, can at present approach the largest problems in the broadest way thoroughly and systematically.

With an income large enough to enter upon some large projects and a number of minor ones, it appears to be wiser, at the beginning, to make a number of small grants and to thoroughly prepare to take up some of the larger projects. With this in view the executive committee recommended to the Trustees that there be placed at its disposal for the fiscal year 1902–'03, two hundred thousand dollars for aid to special researches in various branches of science, and $40,000 for the publication of the results achieved. During the year plans will be perfected, data secured and experience gained that will be of great service in formulating recommendations for the ensuing year.

In the opinion of the committee, the most effective way to discover and develop the exceptional man is to put promising men upon research work under proper guidance and supervision. Those who do not fulfil their promise will soon drop out, and by the survival of the fittest the exceptionally capable man will appear and be given opportunity to accomplish the best that is in him. When the genius is discovered, provide him with the best equipment that can be obtained.

In making grants the wisest policy appears to be to make them to individuals for a specific purpose rather than to institutions for general purposes.

Grants.—Under the authority conferred upon it by the Trustees at their first meeting, the executive committee made three grants, as follows:

March 25, 1902. To the Marine Biological Laboratory, Woods Hole, Mass., for general support	$4,000
April 15, 1902. To Dr. J. McK. Cattell, Columbia University, New York, for preparing a list of the scientific men of the United States	1,000
April 15, 1902. To Dr. Hideyo Noguchi and Professor Simon Flexner, Philadelphia, Pa., for continuation of their studies of the toxicological actions of snake venom and allied poisons	1,000
Total	$6,000

Since the second meeting of the Trustees, on November 25, 1902, the executive committee has made the following grants in the several departments of science mentioned; anthropology, mathematics and other branches will be acted upon later:

Astronomy	$ 21,000
Bibliography	15,000
Botany	11,700
Chemistry	3,000
Economics	15,000

Engineering	4,500
Exploration	5,000
Geology	12,000
Geophysics	8,500
History	5,000
Investigation of project for southern and solar observatory	5,000
Investigation of project for physical and geophysical laboratories	5,000
Investigation of natural history projects	5,000
Marine biological research	12,500
Paleontology	1,900
Physics	4,000
Physiology	5,000
Psychology	1,600
Publications	5,500
Research assistants	25,000
Student research work in Washington	10,000
Zoology	4,000
Total	$185,200

CHARLES D. WALCOTT,
Secretary.

SUMMARY.

As a convenient summary of the plans and methods thus far agreed upon the following minute is approved:

The methods of administration of the Carnegie Institution thus far developed are general rather than specific.

The encouragement of any branch of science comes within the possible scope of this foundation, but as the fund, munificent as it is, is inadequate to meet the requests for aid already presented, not to mention others which are foreseen though not yet formulated, attention has been concentrated upon a selection of those objects which, at this time and in our country, seem to require immediate assistance.

Efforts have been and will be made to secure cooperation with other agencies established for the advancement of knowledge, while care will be exercised to refrain from interference or rivalry with them. Accordingly, ground already occupied will be avoided. For example, if medical research is provided for by other agencies, as it appears to be, the Carnegie Institution will not enter that field. Systematic education, abundantly provided for in this country by universities, colleges, professional schools, and schools of technology, will not be undertaken. Nor will the assistance of meritorious students in the early stages of their studies come within the scope of this foundation. Sites or buildings for other institutions will not be provided.

Specific grants have been and will be made, for definite purposes, to individual investigators, young or old, of marked ability, and for assistance, books, instruments, apparatus and materials. It is understood that such purchases are the property of the Carnegie Institution and subject to its control. The persons thus aided will be expected to report upon the methods followed and the results obtained. In the publication of results it is expected that the writer will say that he was aided by the Carnegie Institution of Washington, unless it be requested that this fact be not made known.

In order to carry out the founder's instructions in respect to bringing to Washington highly qualified persons who wish to profit by the opportunities for observation and research afforded by the various scientific bureaus of the United States Government, a certain sum is set apart for this purpose.

In addition, the Carnegie Institution will appoint from time to time a number of persons to be known as research assistants, who may or may not reside in Washington, and who shall undertake to carry on such special investigation as may be entrusted to them by the Institution. The appointments will be made for a year, and may be renewed in any case where it seems desirable. Permission may be given to go abroad, if special advantages not accessible in this country can thus be secured.

Publication is regarded by the founder as of special importance. Accordingly,

appropriations will be made for this purpose, especially for the printing of papers of acknowledged importance, so abstruse, so extended or so costly that without the aid of this fund they may not see the light.

With respect to certain large undertakings involving much expense, which have been or may be suggested, careful preliminary inquiries have been and will be made.

In order to secure the counsel of experts in various departments of knowledge, special advisers have been and will be invited from time to time for consultation. Valuable suggestions and counsel have already been received from such advisers.

Daniel C. Gilman,
President of the Carnegie Institution.

Washington,
November 25, 1902.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION B, PHYSICS.

The sessions of Section B, in affiliation with the American Physical Society, at Washington, were very successful; the attendance was much larger than has been usual, and it was characterized by the presence of many leading physicists representing a wide territory. Forty-five papers of a high average quality were given; twenty-six of these were presented before Section B, and nineteen before the Physical Society. The number of papers would undoubtedly have been much larger had not this meeting followed so closely upon the Pittsburgh meeting. Nearly every paper drew forth some discussion, though it would seem that this feature of the sessions might be extended with profit. A rough classification of subjects shows that fourteen were on optics, twelve on electricity and magnetism, eight on general subjects, six on heat, three on sound and two on meteorology.

Ernest F. Nichols, vice-president of Section B, and Arthur G. Webster, vice-president of the American Physical Society, were the presiding officers.

In accordance with the revised constitution, several officers were elected to serve at the Washington meeting and also at future meetings, the object being to secure a more consistent and efficient policy of administration. Those officers which serve for several meetings, including the Washington meeting, are Dayton C. Miller, secretary for five years; and the following members of the sectional committee, Gordon F. Hull, five years; Arthur G. Webster, four years; D. B. Brace, three years; Ernest Merritt, two years; Ernest F. Nichols, *ex officio,* two years. The other officers for the Washington meeting, in addition to those mentioned above, were Henry S. Carhart, member of the council; W. S. Franklin, *ex officio* member of the sectional committee; Charles E. Mendenhall, member of the sectional committee; George F. Stradling, member of the general committee, and Lyman J. Briggs, press secretary.

The vice-president for the next, the St. Louis, meeting is Edwin H. Hall, of Harvard University.

On Monday the retiring vice-president, W. S. Franklin, gave an address on 'Popular Science,' which was listened to with great interest, and which drew out some spirited and valuable discussion. The paper has been given in full in a previous issue of Science. The abstracts of the other papers presented before Section B are given below:

The Semidiurnal Periods in the Earth's Atmosphere: Frank H. Bigelow, U. S. Weather Bureau.

There occur at the surface of the earth two types of diurnal periods in the meteorological elements. The temperature,

the wind direction and velocity, and the solar radiation have each one maximum and one minimum; the barometric pressure, the vapor tension, the electric potential have two maxima and two minima. There has been great difficulty in accounting for the simultaneous occurrence of these two types. Lord Kelvin advocates the theory of a forced semidiurnal dynamic wave in the atmosphere, and Dr. J. Hann, after vainly trying to reconcile the temperature and the pressure curves, appears obliged to accept Kelvin's view. Recent observations in the lower strata of the atmosphere with kites and balloons show that the surface double-wave becomes a single-wave at altitudes which are very moderate, about that of the cumulus clouds. It becomes, then, necessary to account for the transformation of the double- into the single-wave within these strata. It is done in this paper by discussing the action of the solar radiation in the atmosphere, and upon the earth's surface; and especially by indicating the effect of the outgoing terrestrial radiation upon the aqueous vapor sheet. This rises and falls daily, and it is shown by the method of volume contents of dry air and aqueous vapor that the known facts harmonize closely with the new theory as set forth by the author. Incidentally, a discussion of the normal solar spectrum energy curves at different temperatures, and the observed depleted energy curve as given by Professor Langley, indicates that the solar constant is probably about 4.0 gram calories and that the temperature of the solar photosphere is not far from 7500° C.

The Construction of a Sensitive Galvanometer. C. G. ABBOTT, Smithsonian Institution. With an introduction by S. P. LANGLEY, Smithsonian Institution.

For the last seven years the galvanometer of the bolometric apparatus of the Smithsonian Astrophysical Observatory has been frequently modified in the interest of greater working sensitiveness. Starting in 1896 with a four-coil instrument of about 25 ohms resistance and with a computed constant of 2×10^{-10} ampères for a ten-seconds single swing, with scale distance one meter, it has now become a sixteen-coil instrument of only 1.6 ohms resistance and with an actual working constant at ten-seconds single swing of 5×10^{-11} ampères for scale distance of one meter. In practice, however, the scale distance is four meters, and one tenth division is readable, so that a current of about 1×10^{-12} ampères can be measured. The paper of Mr. Abbott describes the successive steps by means of which this change has occurred. These include modifications of the construction of support, case, surroundings, coils, needle system and mode of reading.

The Condition Governing the Coherence of Metals when there is an Electrical Discharge between them: CARL KINSLEY, University of Chicago.

In the many studies of coherence that have been made there has usually been a complete disregard of several of the conditions controlling coherence. It is necessary to know not only the potential at which the discharge takes place, but also the quantity of the discharge. The dielectric between the metals and its condition as to temperature and pressure is also of great importance. The condition of the surfaces, their size, shape and distance apart, must be known.

An apparatus enabling distance of the order of one four-hundredth of a wavelength of light to be measured was used. This made it possible to carry on the experimental work within distances such as those found in the usual form of coherer.

A Determination of the Frequency of Alternating Currents by the Automatic Adjustment of the Circuit to Resonance: Carl Kinsley, University of Chicago.

An electric current can be tuned to any frequency within a wide range by varying the self induction of the circuit. This may be automatically accomplished by using a moving core in the coil giving self induction. If the spring-held core is slightly beyond the position of resonance in the direction of too large self induction, it will be retained in equilibrium between the force of the spring and the pull of the coil. The plunger will, therefore, rise and fall in the coil as the varying frequency requires a greater or less self induction for resonance.

Charts were used showing the mode of operation of the method proposed.

On Methods of Measuring Radiant Efficiency: E. L. Nichols and W. W. Coblentz, Cornell University.

This paper deals with the visible and infra-red spectrum of the light transmitted by a water cell and by a water cell and iodine cell in combination, for the purpose of determining the nature of the correction which it is necessary to apply in finding the true radiant efficiency of sources of light. It is shown that in the case of a water cell one centimeter in thickness, at least five sixths of the transmitted energy belongs in the infra-red transparency of an iodine solution which is opaque to the visible rays is not such as to warrant the use of this cell for the purpose of determining the correction for the water cell. Comparison was made between the value for the radiant efficiency by the usual method of the water cell, the same value corrected by integration of the curves for the transmitted energy of the cell and the value of the radiant efficiency obtained by direct integration of the energy curve of the spectrum of the source. The recent contention of Angström that all determinations of radiant efficiency by means of the water cell thus far published give much too large a value, is shown to be fully justified.

The Infra-red Emission Spectrum of the Mercury Arc: W. C. Geer and W. W. Coblentz, Cornell University. Presented by E. L. Nichols.

While investigating the infra-red spectrum of the Aron's lamp, a grouping of the emission lines was observed which is of interest in connection with spectral series.

The vertex of the arc was used for a source of radiation. For this purpose a side tube, having a window of fluorite or rock salt, was placed at right angles to the plane of the arc. The spectrum was produced by means of a mirror spectrometer and rock-salt prism, while a Nicholas radiometer was used to measure the distribution of energy.

The spectrum was explored at every minute, and at certain places every 20″ of arc of the spectrum circle up to 9 μ. It was found that the energy radiated consists of a series of emission bands at 1 μ and 5 μ, with a slight indication of a band at 3 μ. Nowhere in the spectrum was the intensity of the radiation from the arc very great, while beyond 6 μ the deflections due to the hot glass walls of the lamp were as great as those due to the arc. The lamp was kept in a water-bath.

The width of the spectrum covered by the radiometer vane at 1 μ was about .13 μ. The error at 1 μ is less than .01 μ, while at 4 μ the error is perhaps .03 μ.

Since in the region at 3 μ the radiometer showed slight deflections at times which were recorded as questionable, and since in all other parts of the spectrum from 2 to 4 μ no such effect could be detected, one is

led to believe that the indications at 3 μ were real. The great variation in the intensity of these lines may be due, in part, to the fact that the slit subtends different angles in the two regions, and that the suspected line at 3 μ is isolated, while the others occur in a group in which the intensity of each one is influenced by those adjoining it.

The presence of the bands of larger wave-lengths than 4 μ indicates that the true radiant efficiency of the arc is lower than the values found in a previous investigation.

Experiments concerning Very Brief Electrical Contacts: HERSCHEL C. PARKER, Columbia University.

A series of electrical contacts giving a fairly accurate range of adjustment from 0.1 second to 0.00001 second would furnish a valuable means of investigation. A gravity contact key devised by Dr. Charles Forbes gives promise of fulfilling the above conditions. The writer has made many determinations of the times of contact given by the various devices employed on this key, and has also investigated the times of contact of several forms of pendulum.

The method employed was as follows: a condenser of known capacity (F, farads) was charged during the time of contact (T) and the deflection on discharging noted. This deflection (if a good mica condenser is used which has no absorption) is proportional to the electromotive force (E) and the capacity (F). The condenser is again charged through a resistance (R) and the deflection (Q) observed. Then:

$$Q = EF \times (1 - e - T/RF)$$

and,

$$T = -RF \times \log e\,(1 - Q/EF).$$

The 'gravity key' consists essentially of a rectangular weight falling on metal guides, the key being furnished with a scale divided in fractions of a second, according to the law of falling bodies, and the weight actuating the various forms of switches employed. If two switches are used, one to make the contact and the other to break the contact, by placing them at different distances apart on the scale, times of contact varying from 0.4 second to 0.001 second may be obtained. For shorter times a single switch that makes and breaks the contact is made use of, and the time made faster or slower by placing in different positions on the scale so that the falling weight strikes it with varying velocities.

In one form, the weight moves the short arm of a lever, the long arm passing over a contact strip. Another form is one in which the fulcrum of the lever changes, first giving contact and then breaking the circuit immediately afterwards. In still another type the falling weight strikes a lever arm and releases a spring, which makes the contact, and a further motion of the lever breaks the contact, thus giving a differential effect between the velocity of the weight and the rapidity of the spring. With this key it is possible to obtain a contact of only 0.000017 second and with careful adjustment it seems possible to reach 0.00001 second.

Experiments made with pendulums consisting of a steel ball suspended by a wire, and striking against a steel anvil, gave very positive and satisfactory contacts. Using a pendulum with the suspension wire about four meters long and the steel ball two inches in diameter, an arc of $\frac{1}{2}°$ gave 0.00039 second, while a pendulum with a short suspension wire using one-half-inch steel ball, through an arc of 90° gave 0.000079 second.

It is interesting to note that in working with condensers the best mica condenser gives no appreciable variation in capacity

for the very briefest times of charge, while a paraffine condenser may show a reduction in capacity of some sixty per cent. from a time of charge of 0.4 second to that of 0.001 second.

Derivation of Equation of Decaying Sound in a Room, and Definition of Open Window Equivalent of Absorbing Power of the Room: W. S. FRANKLIN, Lehigh University.

1. The paper presents a derivation of the equation

$$i = I\varepsilon^{-\frac{86a}{v}\cdot t},$$

in which I is the initial intensity of sound in a room, i is the intensity t seconds after the source has ceased, v is the volume of the room, a is the open window area which is equivalent to the absorbing power of the wall and objects in the room, and ε is the Naperian base.

2. The paper then gives a definition of the open window equivalent of the absorbing power of the walls and objects in a room.

3. The paper then compares the theoretically derived equation for duration of reverberation, namely,

$$t_1 = 0.165\frac{v}{a},$$

with the equation used by Sabine in which the numerical factor is based upon experiment.

4. The paper then discusses briefly the physical actions involved in the absorption of sound by the walls and objects in a room.

On the Velocity of Light as affected by Motion through the Ether: EDWARD W. MORLEY, Western Reserve University, and DAYTON C. MILLER, Case School of Applied Science.

The theory of the Michelson-Morley experiment contained in their paper of 1887 was elaborated as far as seemed needful in view of the negative result of their experiment. This paper gives some account of a more detailed theory and announces some preliminary results of the more recent experiments.

Some Measures of the Speed of Photographic Shutters: EDWARD W. MORLEY, Western Reserve University, and DAYTON C. MILLER, Case School of Applied Science.

A stroboscopic electrically driven tuning-fork and a special camera containing a cylindrical sensitive film were arranged to obtain graphic representations of the behavior of shutters. The exact manner and time of opening and closing, as well as the aperture and duration of exposure, are recorded.

Of the better grade of shutters designed to give definite and adjustable exposures, it was found that they were fairly constant in operation, but that the actual duration of exposure is often not even approximately that indicated by the maker. Different shutters of the same make and form give widely different exposures when set for the same time. It was found in all the shutters tested that the times marked one seventy-fifth of a second or less were all of the same duration, and that this was much less than the shortest marked time, namely, from three to four thousandths of a second. If the time scale for each separate shutter of this grade were constructed upon tests of the shutter, it might then be used to give practically correct exposures.

With the best shutters of the diaphragm class the duration of exposure is nearly independent of the aperture of the opening.

Some shutters of the cheaper grades designed to give long, medium and short exposures were found to give equal ex-

posures in the three cases. In general, shutters of this grade with timing devices are wholly unreliable.

On the Distribution of Pressure around Spheres in a Viscous Fluid: S. R. COOK, Case School of Applied Science.

When a single sphere is set in motion in a perfect fluid at rest at infinity, its motion is completely determined by the velocity potential due to the motion of the sphere; and the pressure around the sphere is given by

$$\frac{p}{\rho}=\frac{d\varphi}{d\tau}-\tfrac{1}{2}u^2+F(t) \qquad (1)$$

Where φ is the velocity potential and u is the velocity of the sphere at time t.

When u is constant (1) may be written in the form

$$\frac{p}{\rho}=u^2\left\{\tfrac{9}{8}\cos^2\theta-\tfrac{5}{8}\right\}, \qquad (2)$$

where θ is measured from the direction of motion.

The curve for the pressure of a perfect fluid around a sphere was given, and also the curve for the pressure of air, which was determined by measuring the pressure of the air around a glass sphere by means of a water manometer while the air is flowing with a constant velocity past the sphere. The two curves differ, in that, for a perfect fluid the curve is symmetrical with respect to both axes, as may be seen from (2), while for a viscous fluid, *i. e.*, air, the curve is symmetrical with respect to the axis parallel to the direction of flow, but not with respect to the axis at right angles, the pressure at the rear being less than that in front of the sphere.

The pressure was also determined for two spheres moving in line of centers and for two spheres moving perpendicular to the line of centers. The equations which represent the pressure for a perfect fluid were given and the curves of pressure around the spheres compared with the curves obtained by measurements of the pressure in air. It was found that two spheres moving in the line of their centers in a perfect fluid are repelled, but when moving in a viscous fluid are attracted. For spheres moving perpendicular to their line of centers in a perfect fluid they were attracted, and in a viscous fluid repelled.

These results agree with results given in a former paper on 'Flutings in a Sound Wave' and corroborate the theory there advanced as an explanation of the cause of the flutings in a Kundt-tube.

A Portable Apparatus for the Measurement of Sound: A. G. WEBSTER, Clark University.

An improved form of the instrument shown at the Boston meeting, 1898.

The apparatus consists of two parts, a 'phone,' or apparatus for emitting continuously a pure tone, whose intensity is measured in absolute units (watts), and of a 'phonometer,' or instrument which measures at any point the intensity of the sound emitted by the phone or other source of sound measuring the absolute compression of the air. The amplitude of a diaphragm forming the back of a resonator is measured by the displacement of fringes in an interferometer, observed stroboscopically. Both parts of the apparatus are portable, and suitable for field work.

The Mechanical Efficiency of Musical Instruments as Sound Producers: A. G. WEBSTER, Clark University.

The sound emitted was measured by the phonometer, by comparison with the phone placed in the same place where the instrument was. The input of energy was obtained by measurement of the pressure, and time rate of air consumption for wind instruments, and by the pull of the bow and velocity for stringed instruments. Preliminary results were given for the

cornet, French horn, bombardino, saxophone, clarinet, oboe, voice and violin. The mechanical efficiency is generally between one thousandth and one hundredth. An idea of the magnitudes involved can be got from the statement that the sound emitted from five to ten million cornets would equal a horse-power.

The Damped Ballistic Galvanometer: O. M. Stewart, University of Missouri.

It is usually assumed that a ballistic galvanometer if well damped does not give deflections strictly proportional to the quantity of electricity discharged through it. It has, however, been found experimentally that such an error if any is very small. The theory of the ballistic galvanometer is developed for the two general cases: (1) periodic vibrations, and (2) aperiodic vibrations. In both cases the deflection is strictly proportional to the quantity discharged through it. Effect of the damping on the sensibility of the galvanometer is discussed.

On the Electrical Conductivity of Solutions in Amyl Amine: Louis Kahlenberg, University of Wisconsin.

The dielectric constant of amyl amine is 4.50, while that of chloroform is 3.95 and that of ether is 4.37. Chloroform solutions that conduct electricity appreciably are unknown; ethereal solutions are also extremely poor electrolytes. Ferric chloride dissolved in chloroform or ether yields solutions that are practically insulators. It was, therefore, of interest to determine the conductivity of solutions in amyl amine. The amyl amine was dried with fused caustic potash and redistilled. Its specific conductivity was less than 8.2×10^{-8}. Cadmium iodide, silver nitrate and ferric chloride are soluble in amyl amine, and the solutions are electrolytes. Their conductivity was measured by means of the Kohlrausch method. In the case of cadmium solution the molecular conductivity first increases with the dilution and then it increases on further dilution, the maximum (0.542) occurring when one gram molecule is contained in about one and one tenth liters. The mol. cond. is almost *nil* when one gram mol. is present in six liters. Silver nitrate solutions act similarly, the maximum (1.48) occurring when one gram mol. is present in about one and two tenths liters. The cond. is exceedingly low when one gram mol. is contained in 31 liters. In the case of ferric chloride the mol. cond. decreased continuously (from 0.217 at $v = 5.021$) as the solution became more dilute, rapidly dwindling to a very small value at about the same concentration as the $AgNO_3$ solutions. The conductivities of solutions of these three salts at higher dilutions than those mentioned were found to be practically negligible. The results show that, contrary to what one would expect according to the Nernst-Thomson rule, amyl amine yields solutions that conduct well enough readily to admit of measurement. Again the change of the mol. cond. as the solutions are diluted is such that it can not be harmonized with the theory of electrolytic dissociation. The fact that the mol. cond. dwindles to practically nothing in solutions of the concentration above mentioned is particularly interesting. Potassium iodide and sodium oleate are insoluble in amyl amine. Copper oleate is soluble, but the solutions conduct no better than the pure solvent.

On the Thermal Conductivity of Glass: H. W. Springsteen, Case School of Applied Science.

Some Relations between Science and the Patent System: Charles K. Wead, U. S. Patent Office.

This informal paper will call to the at-

tention of the section as it meets in Washington certain unique opportunities for research afforded to the public by the Patent Office and printed patents.

The relations may be grouped under three heads:

1. The patent system, its laws, methods and collections, as an organized body of material.

2. Scientific men as inventors and patentees.

3. The usefulness of printed patents to scientific men.

Why the E.M.F. of the Daniell Cell changes when the Densities of the Solutions Change: HENRY S. CARHART, University of Michigan.

In my paper read at the Pittsburgh meeting of the American Association for the Advancement of Science I applied the increase of thermo-electromotive force per degree between a metal and a solution of one of its salts with the density of the solution to the above problem. An increase in the density of the zinc sulphate solution increases the back thermo-electromotive force, and so decreases the E.M.F. of the cell as a whole.

The writer's explanation has been criticised on the ground that the heat of formation of both zinc sulphate and copper sulphate, in aqueous solution, decreases as the density increases. The result would appear to be a rational explanation of the change of E.M.F. of the Daniell cell without any regard to the thermo-electromotive force and its variation with the density of the solution.

To test this question I have measured the E.M.F. of a Daniell cell of a special form set up with concentrated copper sulphate solution, and, first, with $1/16N$ zinc sulphate solution; and, second, with a normal zinc sulphate solution. The E.M.F. in the second case is less than in the former by 0.021 volt at 20° C. The difference calculated from the thermo-electromotive forces is 0.029 volt, without taking into account the E.M.F. at the junction of the two solutions. The thermal E.M.F. is then abundantly large enough to explain the phenomenon.

Further, the most interesting fact about this is that the observed change of E.M.F. of the Daniell cell is exactly the E.M.F. of a concentration cell set up with the two zinc sulphate solutions. A little consideration shows that such should be the case, but I am not aware that this point has been observed before.

Preliminary Report on an Absolute Measurement of the E.M.F. of the Cadmium Cell: HENRY S. CARHART and KARL E. GUTHE, University of Michigan.

The paper will describe the preparation of the materials for the cadmium cells used, will give a comparison of their E.M.F.'s, will describe the new electrodynamometer built for the measurement of the current which produces a fall of potential over a known resistance, this fall of potential being compared with the E.M.F. of the cadmium cell. If secured in time, some results of the measurement will also be given.

The Characteristic Absorption Curves of the Permanganates: B. E. MOORE, University of Nebraska.

A spectrophotometric study of solutions of potassium and zinc permanganate was made. These solutions were prepared nearly saturated (concentration not yet determined). Then solutions diluted 10, 100 and 1,000 times were studied.

For all points in the spectrum the value K (the thickness of the standard concentration which would absorb ninety per cent. of light) is calculated. This value changes from point to point in the spectrum, but should not change at any fixed point in

the spectrum upon dilution, unless some change in the solution occurs. The strongly absorbing region of these solutions shows five bands. Ostwald shows that twelve permanganates in dilute solution show identical positions for four of these bands, which suggests at once identical color for common ions. Indeed, Ostwald gives a large series of solutions of different common ions to support this conclusion. Still, it must be readily recognized that the color of a solution is determined by the magnitude of absorption, both inside and outside the absorption band, as well as by the position of the bands. This determination requires a spectrophotometric study, although it is a tediously slow process in comparison to the other method. Spectrophotometrically studied those two permanganates show that the bands are identical for both substances in all concentrations. For the potassium permanganate the relative transparency in the band region increases slightly upon dilution. The zinc permanganate remains constant for all concentrations in this region. Outside the characteristic absorption bands, in both blue and red, both solutions show marked increase in relative absorption upon dilution. That is, increased ionization has caused a change *outside* the bands, not *in* the band region itself.

Note: Even in concentrated solutions, permanganates would have a large dissociation coefficient, hence a small difference in ionization could only be realized upon great dilution. Owing to the slight solubility of several permanganates, one is still farther restricted in the choice of substances. Hence so far I have only been able to examine the two substances.

The Magnetic Rotary Dispersion of Solutions of Anomalous Dispersive Substances: F. J. Bates, University of Nebraska. Presented by D. B. Brace.

The rotation of the plane of polarization of a ray of light, when passed through a substance in a direction parallel to the lines of force, has been found on theoretical grounds to be proportional to $du/d\lambda$, where u is the index of refraction of the substance for the wave-length λ. Consequently in solutions showing anomalous dispersion there should be an anomaly in this rotation wherever there is an anomaly in the refractive index. The author has studied very dilute solutions of fuchsin, cyanin, analine (blue) and litmus with an improved form of polariscope. The mean error of a setting for any wave-length was less than .01°; while the best results claimed by previous investigators, who obtained anomalous effects, is a probable error of .03°.

The first observations indicated that the apparent anomalies were present in these solutions; but further investigation proved them to be spurious. After eliminating these effects no anomalies were obtained. Hence, although anomalous dispersive substances may possess an anomalous Faraday effect, its magnitude is much less than it has heretofore been considered.

The Investigation of the Atmospheric Circulation in the Tropics: A. Lawrence Rotch, Blue Hill Meteorological Observatory.

It is generally believed that the currents which ascend from the thermal equator proceed immediately as southwest and northwest anti-trades over the northeast and southeast trades-winds, and that the greater part of the anti-trade descends to the surface of the ocean north and south of the trades and continues to the poles as the prevailing southwest or northwest winds of the north or south temperate zones. This hypothesis is not sustained by the observations of the movements of volcanic dust and of upper clouds, which indi-

cate a strong easterly wind above the equator, shifting suddenly, at about 20° north and south latitudes, to southwest and west. We do not know the depth of the trades, and nothing about the vertical variations of temperature and humidity over the ocean, nor whether sudden changes in these elements occur between the trade and the anti-trade.

The author proposes to investigate these and other questions by means of kites carrying self-recording instruments which, flown from his observatory on Blue Hill, near Boston, during the past nine years, have much increased our knowledge of the atmosphere in this region up to a height of three miles. Experiments made by him in 1901, in flying kites from a steamer crossing the north Atlantic, proved that in this way observations could be obtained in the upper air independently of the wind.

He now desires to make these atmospheric soundings between the Azores and Ascension Island, and is endeavoring to obtain the funds necessary to charter and equip a steamer, believing that in this way some of the most important problems in meteorology and physical geography may be solved.

Anomalous Dispersion and Selective Absorption of Fuchsin: WM. B. CARLMEL, National Bureau of Standards. Presented by D. B. Brace.

To give a brief and concise account of this work, I may state that it consists of a determination of the dispersion curve by interferential means, and of the absorption by means of a Brace spectrophotometer. The methods of procedure have necessarily been somewhat novel because fuchsin is so strongly absorbing that it is not possible to determine the dispersion curve in the usual manner.

The chief difficulty in the determination of the dispersion curve by interferential means is that the light of one path of the interferometer, after passing through the film, is so reduced in intensity that it is too weak to produce interference when it meets the undiminished light from the other path. By partly balancing up the intensity of the two paths by means of an absorbing screen, and by using a form of interferometer which only allowed the light to traverse the film once, and which rejected the enormous amount of light reflected from the surface of the film, it was found possible to obtain good fringes throughout the visible spectrum. The retardations were determined by means of spectral bands, using a mica compensator.

The absorption of the same specimen of fuchsin was determined by means of a form of spectrophotometer which allowed an unusually great intensity of light to be used. The absorption has only been determined in part before, because of the difficulties encountered. A complete determination has been made throughout the spectrum, which agrees quite well with the values found by other experimenters in the portion of the spectrum in which they had made measurements.

The work was done upon films of from 0.2 micron thick to 0.6 micron thick. The thicknesses were determined from the interference bands of thin films, and are correct to within about four or five per cent.

The Coefficient of Expansion of Some Alloys of Nickel and Cast Iron: THEO. M. FOCKE, Case School of Applied Science.

In Appendix No. 6 of the report of the Coast and Geodetic Survey for 1900, Mr. E. G. Fischer describes a new precise level, in which an alloy of nickel and cast iron replaces the brass ordinarily used.

The experiments described in this paper were undertaken to find the composition

of the alloy which should have the least coefficient of expansion. The results are given in the following table:

Percentage.			Mean
Nickel.	Cast Iron.	Coefficient.	Temp.
$33\frac{1}{3}$	$66\frac{2}{3}$	.00000543	31.5
35	65	.00000410	31.5
36	64	.00000397	31.0
$36\frac{1}{2}$	$63\frac{1}{2}$	.00000403	32.0

Sulphur Dioxide and the Binary-Vapor Engine: R. H. THURSTON, Cornell University.

A New Apparatus for Demonstrating Wave Motion: FRED. J. HILLIG, St. John's College.

The instrument is used to demonstrate the theory of radiation, particularly the different wave-forms (longitudinal and transversal), polarization and diffraction. The apparatus consists of a network of rubber strings, at the intersection of which lead balls are suspended.

Demonstration of a Portable High Tension Coil and Ozone Generator: G. LENOX CURTIS, New York city.

For several years I have been experimenting with a high tension coil which is attached to the street main of 110 or more volts. The current is multiplied to one million volts, while the ampèrage is reduced to a fraction of one ampère. The object of the apparatus is to produce ozone for therapeutical purposes. It apparently has but a single pole, the atmosphere being the negative pole.

To the coil are attached ozone generators, inhalers, Geisler and X-ray tubes. The apparatus is portable and can be used wherever there is an incandescent current, or the current may be supplied from a battery; it is, therefore, adapted to sickroom practice. The current and ozone, by this device, may be carried into and through the body, oxidizing pathogenic conditions, reestablishing nutrition, and restoring the blood to normal. There is no shock nor unpleasant feeling to the patient. This method as demonstrated by five years' active practice, in which many diseases have been treated, is probably the most effective of any now in vogue. It appears to be equally advantageous in the treatment of acute and chronic cases. It quickly reduces fevers, controls pneumonia and diseases of suppurative character, and increases vitality. By passing the electrode over the body, superficial and deep-seated congestions may be located, and within an unusually short period normal circulation is reestablished. This fact has been demonstrated in the treatment of meningitis, pneumonia, tuberculosis, neuritis, etc., and the long chain of affections arising from autointoxication is virtually controlled. Sufficient ozone can be generated by this device to quickly disinfect the sickroom or hospital ward.

DAYTON C. MILLER,
Secretary of Section B.

MEETING OF THE AMERICAN PHYSICAL SOCIETY.

ON Wednesday, December 31, a joint meeting of Section B and the American Physical Society was held, at which Professor A. G. Webster, vice-president of the society, presided. The annual election resulted in the choice of the following officers for the current year:

President—Arthur G. Webster.
Vice-President—Elihu Thomson.
Secretary—Ernest Merritt.
Treasurer—William Hallock.
Members of the Council—W. F. Magie and E. H. Hall.

The first paper on the program was by Dr. L. A. Bauer, 'On the Results of Comparisons of Magnetic Instruments.' These comparisons had been made by the magnetic survey and showed a very satisfactory agreement among the different instru-

ments used, which represented types from all parts of the world. Mr. Bauer referred especially to the satisfactory performance of certain earth inductors, which were able to give dip determinations with such accuracy as to readily show the diurnal variations. Mr. Bauer also gave a report of the observations made at the time of the solar eclipse in 1901 to detect the presence of magnetic disturbances accompanying it. Observations had been made at thirty different points distributed all over the world. Unmistakable evidences of magnetic disturbances were shown by the curves exhibited, the maximum of the disturbance occurring at the time of totality. Since the time of totality was widely different at different points, the effect observed could not be due to disturbances of the ordinary kind.

Professor E. F. Nichols and G. F. Hull presented a very interesting paper giving the final results of their work on the 'Pressure Due to Radiation.' Since their first work on this subject alterations in the apparatus had been made which permitted of much greater accuracy in the results. The pressure as computed from the observed energy of the radiation used was found to agree with the pressure actually observed to within 1 per cent., the greatest variation being 1.1 per cent. and the more usual variation being about 0.6 per cent. The effect of wave-length on the pressure was tested by using light which had been filtered through a water cell or through red glass. In each case the pressure was found to depend upon the energy only, and no indication of any dependence upon wave-length was observed. This is in accordance with theory.

In connection with this work the authors also described an experiment by which something greatly resembling a comet's tail was obtained under conditions approximating those of nature. A powder consisting of a mixture of emery and puff-ball spores was placed in a vacuum tube constructed somewhat like an hour-glass. The vacuum was made as perfect as could be obtained, precautions being also used to get rid of mercury vapor. Upon pouring the powder from one part of the tube to the other, and at the same time concentrating upon it the rays from an arc, the lighter portions of the powder were seen to be blown out as though repelled by the light, and presented an appearance quite similar to that of a comet's tail. The effect was of the same order of magnitude as would be expected from the authors' values for light pressure. The authors considered it quite possible that the phenomena might in part be due to other causes; but even if this is true the experiment reproduces the behavior of a comet's tail with great accuracy. The apparatus used in measuring light pressure and with the tube showing the laboratory comet's tail were exhibited.

Professor E. H. Hall gave a historical account of the various experiments that have been made to detect a southerly deviation of a falling body, and described recent experiments by himself on the same subject. With suitable precautions to avoid disturbances, nearly 1,000 balls had been dropped through a distance of about 23 meters. The average deviation toward the south was 0.05 mm. The results are especially interesting, since the theory of the subject as developed by Gauss and others does not indicate that any deviation should be expected, while most previous experiments, like those of Professor Hall, indicate a slight effect.

The papers by J. R. Benton, viz., 'The Elasticity of Copper and Iron at —186° C.,' 'Thermodynamic Formulæ for Isotropic Solids Subject to Tension' and 'Experiments in Connection with Friction Between Solids and Liquids,' will have been

published in full* before the appearance of this account.

The first results of a determination of the Heat of Vaporization of Oxygen were reported by Dr. J. S. Shearer. The method used was an electrical one similar to that already used by the author with liquid air. The value obtained was 58.9. Experiments to determine the heat of vaporization of nitrogen were in progress, but not yet completed.

Professor R. W. Wood described and exhibited a screen which was transparent to ultra-violet light, while being opaque to the rest of the spectrum. Such a screen is very useful in photographing ultra-violet spectra, since it enables the overlapping spectra of other orders to be eliminated. The author showed an interesting lecture experiment in which the rays of the lantern, after passing through such a screen, were concentrated to an invisible focus where a suitable fluorescent substance was excited. The screen was made by combining a gelatine film containing nitroso-dimethyl-analine with copper oxide and cobalt glass.

A group of papers dealing with radio-activity occupied the first half of the Wednesday afternoon session and aroused much interest. It is a subject for congratulation that work along these lines is increasing on this side of the Atlantic, and that so many important papers dealing with the subject should be presented to the Physical Society. In a paper on the 'Magnetic and Electrical Deviation of the Easily Absorbed Rays from Radium' Professor Rutherford described experiments showing that these non-penetrating 'α-rays' are slightly deviated in passing through a magnetic field. The deviation is opposite in sense to that of the cathode rays. The deviation of the α-rays in an electric field is also opposite to that of cathode rays. It would, therefore, appear that these rays are in all likelihood *positively* charged particles. Both the magnetic and the electric deviations were very small. In order to get results it was necessary to use intensely active radium and strong fields. The author's measurements indicate for the velocity a value of about 2.5×10^4 cm./sec., and for the ratio of charge to mass the value 6×10^3. It would thus appear that the α-rays are similar in character to the 'canal rays' of the vacuum tube, the size of the particles constituting the rays being comparable to the size of atoms. The author pointed out that this result is in harmony with the fact previously observed that the coefficient of absorption of a substance for such rays depends upon the thickness of the absorbing layer already traversed and increases rapidly with this thickness.

An article by Professor Rutherford and Mr. H. L. Cook, on a 'Penetrating Radiation from the Earth's Surface,' gave the results of experiments which indicate that part at least of the so-called spontaneous ionization of air in a closed place is due to radiation from outside. It was found that in a closed vessel surrounded by a screen of lead one inch thick the ionization was reduced to 68 per cent. of the value obtained without the lead. The results indicated that the rays, which were in part absorbed by the lead, proceeded from all directions and originated at or near the surface of all bodies in the neighborhood. The authors were of the opinion that the ionization upon the interior of a closed vessel was due in part also to a radiation proceeding from the surface of the surrounding vessel. This was made probable by the fact that a screen of iron seemed to be more effective in reducing the ionization than one of lead, while if the vessel containing the air was

* *Physical Review*, January, 1903.

sunk in a tank of water the action could be reduced still further. The assumption that iron and water radiate less strongly than lead would explain these results. In the case of lead the presumably more complete absorption of the rays from outside is more than balanced by the increased radiation from the metal itself.

Professor McLennan, of Toronto University, reported the results of experiments made at the foot of Niagara Falls to determine the induced radioactivity at that point. An insulated wire mounted immediately at the foot of the falls on the American side and maintained at a negative potential was found to acquire a much less induced activity than would be acquired by the same wire under similar circumstances at Toronto. It was found unnecessary actually to charge the wire when at the foot of the falls, since it received a negative charge from the air or spray, the potential being about that needed for the experiment. The activity acquired at the foot of the falls was found to be only about one sixth of that obtained at Toronto. The author also described experiments made in the neighborhood of a static machine in operation. It was found that the activity acquired by a metal disk when placed near the machine and negatively charged was much less than when the same disk was placed at a greater distance. It was also found that the activity acquired by a body placed in a closed room diminished with time.

A paper by Professor McLennan and Mr. E. F. Burton on the 'Electrical Conductivity of Air' dealt with experiments somewhat similar in character to those described in the paper by Rutherford and Cook mentioned above. It was found that air placed in a closed vessel showed at first a rapid diminution in conductivity, but that later its conductivity increased again. The effect was more marked at greater pressures. The general form of the curve showing the variation of conductivity was the same for vessels made of different materials, but the initial diminution and subsequent increase of conductivity were much more marked in some than in others. The authors think that the result is due to an emanation or radiation issuing from the walls of the containing vessel. The rapid decrease in conductivity at first is due to the dying out of the conductivity originally possessed by the air, while the subsequent increase is the result of the emanation or radiation from the walls. It will be noticed that this conclusion is practically the same as that reached by Rutherford and Cook. The fact that the results of these entirely independent experiments should be announced at the same meeting of the Physical Society presents an unusual and interesting coincidence.

A paper on the 'Radioactivity of Freshly Fallen Snow,' by Mr. S. J. Allen, showed that snow, like rain, possesses marked radioactivity, which, however, is rapidly lost. The activity of snow was found to fall to one half its initial value in thirty minutes. If the snow is melted and the resulting water evaporated something possessing radioactivity is left behind. The radiation from snow consists chiefly of the easily absorbed rays. In the discussion of this paper Professor McLennan stated that he had found that after a fall of snow a negatively charged wire acquired less activity than before the snowstorm. It would seem as though the active constituent of the atmosphere had been removed by the snow.

In a paper 'On the Double Refraction of Dielectrics in a Magnetic Field in a Direction at Right Angles to the Lines of Force,' by D. B. Brace, the author called attention to the fact that the existence of double circular refraction along the magnetic

lines of force has been definitely established from theoretical considerations. Voigt has obtained equations which indicate not only this result, but also double refraction at right angles to the lines of force. The experimental results of Voigt apparently confirm this conclusion for glass and sodium vapor. The author calls attention to the fact that the results obtained by Voigt might be due to the Faraday effect. He finds this to be the case with glass, but confirms Voigt's conclusion for sodium vapor.

The next paper was by Professor A. Wilmer Duff, on the 'Viscosity of Liquids at Low Rates of Shear.' According to ideas developed by Poisson, Maxwell, and others, a liquid differs from a solid in having either a low modulus of rigidity or a high rate of relaxation under shearing stress, and the coefficient of viscosity contains a term that varies inversely as the rate of shear. Experiments by Professor Duff, made at a rate of shear about 1,000 times lower than the lowest in Poisenille's experiments, seem to show that, while the coefficient of viscosity of kerosene is the same within rates of shear that vary as 50,000 to 1, that of water is slightly larger at the low rates of shear than at the high rates used in Poisenille's experiments. This might be interpreted as indicating a definite, although very narrow, limit of perfect elasticity for water under shearing stresses.

'Results of Determinations of the Mechanical Efficiency of Musical Instruments,' were presented by Professor A. G. Webster. The determinations were made with the help of the apparatus designed by the author for sound measurements, which was described at the April, 1902, meeting of the Society. The efficiencies obtained were extremely small, indicating that sound-producing machines are even more inefficient than those used in producing light.

A paper by Dr. Herschel C. Parker on 'Experiments with Very Brief Electrical Contacts' gave an account of tests of a gravity contact key devised by Dr. Charles Forbes. The apparatus itself had been exhibited at a former meeting. Dr. Parker finds that reliable contacts can be obtained ranging in duration from 0.1 sec. to about 0.00001 sec.

Brief papers by Professor W. J. Humphreys, on 'A Comprehensive Boyle's Law Apparatus' and 'A Lecture-room Method of Analyzing Irregular Electric Currents,' dealt with these subjects from the pedagogical standpoint.

The last paper on the program was by Dr. C. A. Skinner, on the 'Critical Current Density and Cathode Drop in Vacuum Tubes.' The author referred to the difference in the formulæ obtained by Stark and himself giving a relation between cathode drop, current density, and pressure. Dr. Skinner explains the difference as due to the fact that wire electrodes were used in the experiments of Stark, while in the case of his own experiments disk electrodes had been used.

As one day proved too short a time to complete the program of the society, the joint meeting with Section B was continued on Thursday, January 1, a number of the above-mentioned papers being presented on that day. The meeting may properly be regarded as one of the most interesting and successful which the society has ever held.

Ernest Merritt,
Secretary.

SCIENTIFIC BOOKS.

A Nature Wooing at Ormond by the Sea. By W. S. Blatchley, author of 'Gleanings from Nature.' Indianapolis, The Nature Publishing Company. 1902. 12mo. Pp. 245.

The author went to Florida in the early

part of 1899 in the quest of health and occupied himself by observing 'facts and fancies about animals and plants.' His place of residence was about a hundred miles south of Jacksonville. His observations, with occasional reveries on other subjects, combined with remarks upon the conditions prevailing in the times of Bartram, Michaux and Say, make up the chief part of the volume. In an appendix he presents a list, with notes, of one hundred and fifty species of insects collected.

The most important discovery made was that of the left humerus of the great auk from a large shell mound on the Spanish Grant. The writer found a second specimen of a similar animal thirty feet distant from the one obtained by Mr. Blatchley (see SCIENCE, XVI., p. 203). Hence it would seem as if the facts were well established that the great auk was once a resident of Florida, and presumably of the whole Atlantic coast.

This mound is over one thousand feet long and ten feet thick, composed largely of the shell of the *Donax,* which is still used for food. Twenty-seven other species of mollusca were secured, besides several fish, turtles, alligators and half a dozen mammals. A few implements were also picked up.

The author presents his facts in a very pleasant way, easily appreciated by all intelligent people, apart from tourists and scientists.

C. H. HITCHCOCK.

HANOVER, N. H.

SCIENTIFIC JOURNALS AND ARTICLES.

Journal of Physical Chemistry, December.—'On the Passage of a Direct Current Through an Electrolytic Cell,' by S. L. Bigelow. A study of the cause of the residual current when the electromotive force is below the decomposition point. 'On the Critical States of a Binary System,' by Paul Saurel. 'Deduction of the Magnitude of the Osmotic Pressure in Dilute Solutions according to the Kinetic Theory,' by Peter Fireman. The deduction is drawn that the osmotic pressure of a substance in dilute solution is equal to the corresponding gas pressure of that substance at the same temperature. The conclusion is also drawn that, in general, the kinetic energy of the molecules of a liquid is equal to that of gas molecules at the same temperature. This number of the *Journal* also contains the index to Volume VI.

January.—'The Rate of Oxidation of Ferrous Salts by Chromic Acid,' by Clara C. Benson. This paper includes an analytical method for determining ferrous iron in the presence of ferric salts and chromic acid. 'Electromotive Force of Alloys of Tin, Lead and Bismuth,' by E. A. Shepherd. 'Reduction of Insoluble Cathodes,' by Alfred T. Weightman. Chiefly a study of the reduction of lead sulfid. 'Electrolytic Preparation of Sodium Amalgam,' by E. S. Shepherd.

THE *Journal of Comparative Neurology* for December contains the following articles: 'On the Origin of Neuroglia Tissue from the Mesoblast,' by Shinkishi Hatai. Describes and figures the proliferation of neuroglia cells from the walls of the embryonic capillaries. 'On the Number and on the Relation between Diameter and Distribution of the Nerve Fibers Innervating the Leg of the Frog,' by Elizabeth Hopkins Dunn. A continuation and control of a previous study, showing, among other conclusions, that the largest nerve fibers do not run the longest course, as Schwalbe supposed, but terminate in the thigh. In the next paper, 'A Note on the Significance of the Size of Nerve Fibers in Fishes,' by C. Judson Herrick, this conclusion is confirmed for the fishes, and observations presented tending to show that the size of nerve fibers, within certain limits, is determined by the state of functional development of the organ innervated. 'The Eye of the Common Mole, *Scalops aquaticus machrinus,*' by James Rollin Slonaker. The eye is described in detail and found to be in so greatly reduced condition as to render it very improbable that it can function at all. Twenty pages of book reviews complete the number.

SOCIETIES AND ACADEMIES.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

THE 174th regular meeting was held on January 8, 1903, eighteen members and two

visitors present. Officers for 1903 were elected as follows:

President—Mr. D. W. Coquillett.

Vice-Presidents—Mr. Nathan Banks and Dr. A. D. Hopkins.

Recording Secretary—Mr. Rolla P. Currie.

Corresponding Secretary—Mr. Frank Benton.

Treasurer—Mr. J. D. Patten.

Members of the Executive Committee (in addition to the officers)—Dr. H. G. Dyar, Dr. L. O. Howard and Mr. C. L. Marlatt.

Mr. W. E. Hinds, Field Agent in the Division of Entomology, U. S. Department of Agriculture, was elected a corresponding member.

Dr. Dyar read his address as retiring president, entitled 'Recent Work in Lepidoptera.' The author stated that the classification of Lepidoptera, ten years ago, stood essentially as in the time of Linnæus. During the past few years, however, material changes have had to be made as the relationships of families and genera have come to be better understood. The studies of Meyrick, Hampson, Chapman and Tutt in England, and those of Comstock, Packard, Kellogg, Bodine and the author in America, have led them to adopt a common general scheme of classification, though difference of opinion still exists as to the details of this scheme. The author reviewed briefly the work of recent American lepidopterists. Taking up the butterflies, he compared the work of Scudder and Edwards, mentioning also that of French, Holland, Skinner and Beutenmüller. He then spoke of what has been done in the different groups of moths—in the Sphingidæ by Beutenmüller and Packard, in the Saturnians by Neumoegen and Dyar and also by Packard, in the Noctuidæ by Grote and Smith, in the Notodontidæ by Packard, in the Geometridæ by Hulst, in the Pyralids by Fernald, and in the Tineids by Lord Walsingham and recently also by Dietz, Kearfott and Busck. The author summed up by pointing out the work particularly needed in the near future, viz., a monograph of the butterflies, comprehensive works on Sphingid and Noctuid larvæ, a monograph of the Geometridæ, supplementing and reviewing Dr. Hulst's work, tables for determining the Tortricidæ, and continued descriptions of new species of Tineids.

Mr. Banks presented his 'Notes on Brachynemuri of the *B. ferox* Group.' A critical study of large series of specimens heretofore determined as belonging to the species *peregrinus, carrizonus, ferox* and *quadripunctatus* resulted in the discovery of three more forms hitherto undescribed. *Brachynemurus peregrinus* Hagen is considered a synonym of *B. ferox* Walker. The author presented descriptions, exhibiting specimens and a plate of drawings showing the inter-antennal and prothoracic markings and profile views of the male anal appendages.

Rolla P. Currie,
Recording Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 135th meeting (tenth annual meeting) was held in Washington, December 17, 1902. Major C. E. Dutton spoke informally of the geologic work of the late Major J. W. Powell, and Mr. Bailey Willis of the work of the late Dr. R. B. Rowe.

After the conclusion of the regular program, the annual meeting was held, at which the reports of the secretaries and of the treasurer were presented. The election of officers resulted as follows:

President—C. Willard Hayes.

Vice-Presidents—G. P. Merrill and Waldemar Lindgren.

Treasurer—G. W. Stose.

Secretaries—Walter C. Mendenhall and Alfred H. Brooks.

Members of the Council—G. O. Smith, T. W. Stanton, T. Wayland Vaughan, David White and Arthur C. Spencer.

Alfred H. Brooks,
Secretary.

NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

A meeting was held November 24, Professor Farrand in the chair. Professor Lough was elected secretary of the section. Mr. J. B. Miner presented the results of some experiments on the perception of time intervals bounded by varied stimuli. Intervals of one, two, three, four and six seconds bounded by sounds, lights, or one sound and one light were given the subject, who then endeavored to reproduce the interval by taps

on a telegraph key. For intervals bounded by sounds the reproduced interval changed from plus to minus at a point between intervals of two and three seconds. There is very little difference between intervals bounded by sounds and those bounded by lights; but a considerable difference is given when the interval is bounded by a sound followed by a light or *vice versa*. The same interval bounded by varied stimuli seemed to the subjects to be longer than when bounded by like stimuli. Memory of intervals bounded by varied stimuli required more effort. Mr. Miner believed that this represented the difference in difficulty of muscular adjustment on which the memory of the time interval depended. The increase in variability with the longer intervals followed the law suggested by Cattell and Fullerton, rather than Weber's law.

Mr. Miner also read a paper by Mr. J. H. Bair, who was unable to be present, on the general practice curve. The paper was based on experiments made with a pack of 48 cards (six different pictures, and eight of each picture). The cards when dealt in the same order and then immediately after in a different order required a longer time for the second order. If dealt 2, 3, 4, 5 $\cdots n$ times in the same order before dealing in some new order, the successive practices in the same order followed the law of the practice curve, which is an asymptotic approach to a physiological limit; and at the same time dealing the cards in any order required also less and less time. This shows that practice in one order gives practice ability in another order antagonistic to it, and the more practice in one order the greater the ability to respond quickly to the new order.

Professor MacDougal reported a series of experiments showing the influence of variations in visual stimulation upon reactions to auditory signals. Reaction time was shorter in darkness than in light, in weak light than in strong light and in colored than in neutral light. Reaction time was more constant under neutral than under colored light; changes of quality of light were followed regularly by increased rapidity of reactions. These changes are apparently due to changes in the attentive condition of the reactor, not to any immediate organic influence of the intensity or quality of the light.

JAMES E. LOUGH,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

October 20, 1902.—Professor A. S. Chessin presented for publication a paper on 'Some Relations Between Bessel Functions of the First and of the Second Kind.'

Professor Wm. Trelease exhibited photographs showing the variations in the ring or collar of *Lepiota naucinoides*, and a series of lantern slides illustrating autumnal coloring of foliage.

November 3, 1902.—Mr. G. G. Hedgcock gave an illustrated account of 'The Sugar Beet Industry in the United States and Some of the Difficulties attending It.'

Five persons were elected to active membership.

November 17, 1902.—Dr. M. A. Goldstein addressed the Academy on 'The Uses of the Tuning Fork as a Means of Medical Diagnosis.'

One person was elected to active membership.

December 1, 1902.—Dr. Adolf Alt delivered an address on the 'Development of the Eye,' illustrated by colored drawings and stereopticon views made from sections prepared and photographed by him.

December 15, 1902.—A paper by C. F. Baker, entitled 'A Revision of American Siphonaptera,' was presented and read by title.

Dr. C. B. Curtis delivered an illustrated address on 'Color Photography,' outlining the theory of color vision and the various ways in which a given color sensation can be produced, and describing the processes by which the natural colors of objects can be approximately reproduced by photographic means.

Two persons were elected to active membership.

January 5, 1903.—The reports of officers for the year 1902 were received, and the following officers for 1903 installed:

President—Henry W. Eliot.
First Vice-President—D. S. H. Smith.
Second Vice-President—Wm. K. Bixby.
Recording Secretary—Wm. Trelease.
Corresponding Secretary—Ernest P. Olshausen.
Treasurer—Enno Sander.
Librarian—G. Hambach.
Curators—G. Hambach, Julius Hurter, A. H. Timmerman.
Directors—F. E. Nipher, Adolf Alt.

Mr. Julius Hurter presented a paper entitled 'A Contribution to the Herpetology of Missouri,' illustrated by specimens of nineteen reptiles not included in his former paper on the same subject, and bringing the total thus far recorded for the state up to ninety-three.

Dr. Hermann von Schrenk presented some notes on the bitter-rot disease of apples, referring particularly to recent investigations and cultural experiments. He exhibited specimens of the cankers formed on apple limbs by the bitter-rot fungus (*Glœosporium fructigenum* Berk.) in various orchards, and of the artificial cankers produced in apple trees at the Missouri Botanical Garden by inoculating branches with spores from apples affected with the bitter-rot disease, and spores from pure cultures of the fungus from cankers occurring naturally in the orchard. Cultures showing the perfect or ascus stage of the fungus were exhibited, and attention was called to the fact that up to date the perfect form had been found only in cultures and on several apples kept in the laboratory. He announced the discovery two weeks ago, by Mr. Perley Spaulding, of the perithecia and perfectly formed asci and ascospores of the bitter-rot fungus in several of the cankers produced on apple limbs from pure cultures of the bitter-rot fungus, as well as from bitter-rot spores taken from cankers obtained in an affected orchard. This discovery is considered extremely important, as it demonstrates for the first time, beyond question, that the bitter-rot fungus actually produces its perfect fruit in the cankers, and thereby strengthens the contention that the cankers on apple limbs are actually formed by the bitter-rot fungus. The asci are apparently as evanescent in the cankers as they are in the cultures, and it is, therefore, not at all improbable that many of the supposed pycnidial spores found in both the natural and artificially produced cankers were really ascospores. Drawings were exhibited showing the perithecia found in the cankers with asci and ascospores.

Two persons were elected to active membership.

William Trelease,
Recording Secretary.

TORONTO ASTRONOMICAL SOCIETY.

During the November and December sessions of this society, W. F. King, Government Astronomer at Ottawa, contributed a paper dealing with the general outlook of 'Astronomy in Canada.' A detailed description was given of the new government observatory at Ottawa, which was now nearing completion, and its equipment. The instruments being set up were said to be of superior excellence, the optical parts of the large telescope and most of the other instruments being the work of John A. Brashear, of Allegheny, Pa. Mr. King was quite sanguine of the future of the institution under his control.

C. A. Chant, M.A., Ph.D., first vice-president, contributed a paper dealing with 'New Developments in Wireless Telegraphy,' with special reference to the labors of Marconi. Upwards of fifty lantern slides were shown, illustrating the development of method and apparatus used from Hertz to Braun of Strassburg, Professor Slaby of Berlin and Professor Fessenden, late of the U. S. Weather Bureau, up to November, 1902. Reference was made to the desirability of knowing the precise nature of the office rendered by the ether in originating and transmitting these electric waves or shocks, and also the nature of the oscillations about the aerial wire, and its earth connection, in order to give a solid scientific basis for further practical developments of the system. Dr. Chant has been doing some original work of value along these lines. The result of some of this work will be found elaborated in the forthcoming number of the *American Journal of Science.*

Under the heading 'Vagaries of the Mariner's Compass' Arthur Harvey, F.R.S.C.,

was able to show, from curves of magnetic variation based on the records of the magnetic observatory, an apparent variation of the *rate of motion* of the north magnetic pole.

J. R. COLLINS,
Secretary.

TORONTO, December 23, 1902.

DISCUSSION AND CORRESPONDENCE.

GUESSES ON THE RELATIVE WEIGHTS OF BILLS AND COINS.

THE question raised in SCIENCE for November 7 as to whether women are capable of making closer estimates than men is an interesting one, but the comparison of results from different colleges is somewhat uncertain. Some of the errors can be eliminated by testing young men and young women from the same state who have always been educated together. The question 'How many one-dollar bills will equal in weight a five-dollar gold piece?' was asked of 76 male and 58 female students of the University of Wyoming with the following results:

Male students: Average guess, 391; median, 56; average variation from the average guess, 516; average variation from the median, 366.

Female students: Average guess, 1,324; median, 50; average variation from the average guess, 2,125; average variation from the median, 1,299.

Since the true number is 7, the guesses of the women are slightly better if we take the median, but the most noticeable point is the much greater variety in the guesses of the women, which is in accordance with the report of Mr. Messenger in SCIENCE for April 25. This agrees well with common observation. Probably most grade books of classes nearly equally divided between the two sexes would show that the highest and lowest marks were given to women.

In the West coin is usually preferred to paper and five-dollar gold pieces are more common than one-dollar bills in Wyoming.

E. E. SLOSSON.

UNIVERSITY OF WYOMING.

THE PUBLICATION OF REJECTED NAMES.

WITHIN the last few days I have received two papers in which rejected manuscript names are published in such a way as to render them valid, as I understand the rules. As there is evidently a misconception or divergence of opinion, it is worth while to discuss these cases.

1. Mr. Nathan Banks, in his most interesting paper on the 'Arachnida of the Galapagos Islands' (*Proc. Wash. Ac. Sci.,* 1902), cites on p. 50 *Filistrata oceanea* and *Loxosceles galapagoensis* Marx MS., n. spp. On p. 51 he states that these were *nomina nuda,* but that they are identical with his species of the same genera described below. On p. 55 the *Filistrata* is described as *F. fasciata,* and the *Loxoceles* as *L. longipalpis.* It is evident that the Marxian names have 'priority of place,' and it is clearly stated that they pertain to the two species described; it seems to me, therefore, that they are valid.

2. Mr. F. H. Knowlton (*Bull. Torr. Bot. Club,* November, 1902, p. 640) gives an account of a fossil fruit from Vermont which he says Lesquereux named in manuscript *Carya globulosa.* A description of the fruit immediately follows the publication of this name; but on the next page we are told that the fruit belongs to *Cucumites,* and 'in view of the fact that *Carya globulosa* was never actually published, it may be appropriate to name it in honor of Lesquereux, who first detected it. It may be called *Cucumites lesquereuxii.*' On the contrary, *C. globulosa* was just then published, and I do not see how we can avoid calling the plant *Cucumites globulosus.*

T. D. A. COCKERELL.

E. LAS VEGAS, N. M.
December 6, 1902.

THE IROQUOIS BOOK OF RITES.

I HAVE before me the La Fort manuscript from which my old friend, Horatio Hale, took the text of the condolence song of the 'Younger Brothers.' It varies considerably from his version, partly from haste in copying, and partly because he made the spelling more consistent in some cases. The differences are mostly in the vowels, but some con-

sonants are not the same. I do not think the sense is changed, but intend to have a new translation made.

Another interesting Indian manuscript in my hands is the Mohawk version of the greater condoling songs. La Fort's is the Onondaga one used at the delivery of the wampum when the curtains are removed. The others are sung at the wayside meeting, and on the march to the council-house, in which they usually end. This version was very plainly written by Chief George Key, of the Grand River reservation, Canada. For mere convenience it is arbitrarily arranged in verses, and it has the valuable feature of a division into syllables throughout. The song with the names was written first, perhaps as being of first importance, but the remaining songs are in the order of Hale's book. There are slight variations from his version, but none of essential importance, except one. Those who have attended a condolence will remember the continual repetition of 'Ha-i-i-i,' much prolonged, and this hardly appears in his book. In the great song with names before me it is written nearly a thousand times. In the one he saw the writer may have spared himself the trouble of writing, knowing just where it should be used. The chiefs' names occur in the usual order, but some of those placed together in Mr. Hale's version are separated in this. The variations in sense are very slight.

The greater songs are always used in the Mohawk version, as this is better adapted to the music used. This music I hope soon to secure.

W. M. Beauchamp.

204 Maple St., Syracuse,
November 19, 1902.

SHORTER ARTICLES.

THE TORTUGAS, FLORIDA, AS A STATION FOR RESEARCH IN BIOLOGY.

The Tortugas, Florida, probably surpasses any other situation in the tropical Atlantic, in the richness of its marine fauna and in natural advantages for the study of tropical life. Until within recent years, however, the inaccessibility of the islands rendered it difficult to maintain even a temporary station upon them, and all of our knowledge of the life of the region is due to the cursory visits of the United States government expeditions in the *Bibb*, 1869; *Blake*, 1877–78, and *Albatross*, 1885–86, as well as to the explorations of Louis Agassiz, 1850–51, and Alexander Agassiz, 1881.

Certain assistants of Alexander Agassiz have also studied the fauna of the Tortugas, and several expeditions not under government control have visited the reefs, notably that of the University of Iowa under C. C. Nutting, in 1893. The latest expedition to the islands was that of the Museum of the Brooklyn Institute of Arts and Sciences in 1902, the results of which have not yet been published.

Since 1898 the United States government has established a naval coaling station upon the Tortugas, and frequent and regular communication with Key West is now maintained by means of a large ocean-going tug. The region has thus recently become accessible, and the time for the establishment of a research station upon the islands is now ripe.

The Tortugas group is composed of seven low, sandy islands and numerous reef flats irregularly disposed so as to partially enclose a lagoon about ten miles long and six miles wide, and having an average depth of about eight fathoms.

Two of the islands are inhabited, Garden Key being occupied by Fort Jefferson, and Loggerhead Key by the Tortugas Lighthouse.

The group is the most recent of the Florida reefs. Pure, deep ocean water surrounds them, and there are none of the extensive mud flats or mangrove-covered shores so characteristic of the keys along the mainland coast of Florida. The northern edge of the Gulf Stream lies about twenty-five or thirty miles south of the Tortugas, and the east to southeast breezes, which prevail during the spring and summer, drift the surface waters of the Gulf Stream upon the Tortugas, giving a remarkable opportunity to study the life of the great tropical ocean current, while at the same time enjoying all of the advantages of a land station, a combination of advantageous conditions which all who have been upon cruising expeditions will appreciate.

Not one of the pelagic animals which abound at the Tortugas has been found living permanently north of Cape Cod, Massachusetts, although a large number of Tortugas species are annually drifted upon the southern coast of New England by the prevailing southerly winds of the summer months. The pelagic fauna of the Tortugas is, on the other hand, closely related to that of the Fiji Islands, both in the nature of the specimens themselves and in the relative abundance of characteristic forms, although slight specific distinctions can usually be perceived which separate the Tortugas from the Fijian forms.

About ten square miles of shallow reef flats lie around the Tortugas Islands and these support a fauna which, for variety and abundance, appears to be unsurpassed by that of any other situation in the Atlantic.

The Madreporaria, however, are poorly represented in the Tortugas, but previous to 1878 the coral reef was remarkable for both the number and variety of species represented. In October of that year a dark-colored water, coming apparently from the mainland of Florida, drifted out over the Tortugas reefs, killing great numbers of marine animals. Practically all of the stocks of *Madrepora murciata* were killed at this time, and this coral is still extremely rare at the Tortugas, only a few stocks being found at depths of two fathoms or more. The genera *Porites, Orbicella* and *Meandrina,* on the other hand, appear to have survived in considerable numbers, for many heads of these corals are now seen, all being far too large to have been formed since 1878.

As a result of one month's collecting in shallow water, it appears that about 265 species of marine animals are very abundant in water less than one fathom in depth, while a far greater number of forms are rare, or found in deeper water.

Several species of gulls nest upon the islands during the summer months, about four thousand of them annually visiting Bird Key late in April and remaining to attend their young until the third week in August. These gulls are the noddy (*Anonus stolidus*), the sooty tern (*Sterna fuliginosa*), the least tern (*S. antillarum*). The man-of-war hawk (*Fregata aquila*), and the Booby (*Sula sula*) are summer visitors. Marine turtles, especially the loggerhead (*Thalessochelys caretta*), were once abundant upon the Tortugas, but are now becoming rare, owing to indiscriminate and constant persecution. A few females still crawl up on the sandy beaches from between the middle of May and the first week in August and dig their nests near the line of the bushes above the reach of the spray. The eggs hatch in about six weeks and the young crawl immediately into the water.

The surface hauls obtained in the Tortugas appear to be richer than those gathered in the Bahama Islands, and this is what we should expect from the prevailing winds which constantly drift the surface waters of the Gulf Stream upon the Tortugas, whereas the Bahama Islands lie to the windward of the great current, which, as every one knows, teems with pelagic life drawn into it from all parts of the tropical Atlantic.

During the summer months the temperature of the air rarely exceeds 95° F. The humidity is very high, however, although the nights are cool, and the gentle breeze drifting almost constantly over the islands renders it possible to retain normal health and energy.

The accommodations at the Tortugas consist in the officers' quarters and barracks at Fort Jefferson, the now deserted quarantine hospital on Bird Key, and the buildings attached to the lighthouse on Loggerhead Key. Officers of the United States government have, upon all occasions, displayed commendable interest in the labors of scientific men at the Tortugas, and have always granted to well-qualified persons the privilege of living within the government buildings. Indeed, our knowledge of the Tortugas fauna is almost wholly due to the efforts of the government in forwarding research in this region, and to the private efforts of Alexander Agassiz, Were a permanent laboratory to be established upon the Tortugas, however, a comfortable, well-ventilated wooden building capable of accommodating from six to twelve investigators would be required. This should

be provided with a windmill to furnish running salt water for aquaria and a tank to retain rain water. The laboratory proper should be a large, well-ventilated wooden building having a good north light. No better room has yet been devised than that of the Newport laboratory designed by Alexander Agassiz, although the ventilation of a tropical laboratory should be provided for with special care.

A small working library and sleeping rooms should be attached to the laboratory, and the kitchen and alcohol storage sheds should be in small separate buildings. Six thousand dollars would be required to construct the laboratory and its accessory buildings.

A seaworthy launch at least 55 feet in length and of light draft would be required. This should be provided with sails, auxiliary naphtha for power, and sounding and dredging reels. Such a launch is necessary, in order to study the life of the Gulf Stream itself and of numerous reefs at the Tortugas and its neighborhood. It should be capable of making the journey to and fro between Miami or Havana and the Tortugas.

The time has come when American men of science should awaken to the fact that we have at our very door a tropical fauna far surpassing in richness that of Naples. With our great wealth and many able and energetic workers, we should begin to perform the task for science which is being so ably done at Naples. The great monographs of the Naples Laboratory should be our incentive to do even more and better things in the development of knowledge concerning the marine life of tropical America.

Alfred Goldsborough Mayer.
Museum of the Brooklyn Institute of Arts and Sciences.

EGG-LAYING IN GONIONEMUS.

In a preliminary report on the life-history of *Gonionemus* (*Jour. Morph.*, Vol. XI., p. 494) I stated that the cause of deposition of eggs was due to the withdrawal of light, as the animals could be induced to deposit the eggs almost any time of day by placing them in the dark for an hour. The next year (1896) some experiments were made with colored light to find if egg-laying could be brought about in more than one way and thus get nearer the cause. As I was not able to continue these experiments and some one else may be in position to do so, I give the substance of a few notes made at the time and the conclusion. The medusæ were exposed in a blackened box, one end of which was closed with a sheet of the desired color glass.

First some medusæ were exposed to yellow-orange light for one hour. The sun was not shining into the box; no eggs were deposited. These were then exposed for one hour to blue light (cobalt glass) and eggs were deposited; they were abnormally slow in segmentation. Next some of the animals were exposed under darker orange glass for two hours and no eggs were deposited. This and a control set were then put in the dark for one hour and in both cases eggs were deposited normally. Two females and a male were exposed under blue glass for one hour. The sun was shining through the glass and it was, therefore, lighter than in the other exposure under the blue. No eggs were deposited within the hour.

Sixteen females and one male were exposed under dark ruby glass for one hour and ten minutes, the sun shining through the glass; no eggs were deposited. In two other trials under the ruby glass when the sun did not shine into the box eggs were deposited. Immediately after the first exposure to red, above, the animals were placed under blue glass and left for one hour and fifteen minutes, and still no eggs were deposited. It took over one and one half hours' exposure to darkness before extrusion took place. Whether the previous exposure to ruby light had a retarding effect or not was not determined. The conclusion drawn was that the colors were not effective as such, but merely as they obstructed the light. It was also found at that time that the gonads removed from the animal deposit the sex products just as well as the intact animal.

L. Murbach.
Detroit, Mich.

MILEY'S PROCESS OF COLOR PHOTOGRAPHY.

FOR two years or so Mr. Miley, a photographer of Lexington, Va., has been using a process of color photography which seems to present distinct advantages over any process heretofore devised, and which promises to make color photography a complete success. Mr. Miley is a skilled photographer, and has spent much of his time in experimentation, often with no little success. His process of color photography is the outcome of some of these experiments, and can not be considered as a development of any of the other processes in use, none of which has such practical possibilities. Mr. Miley has made and sold many of these color photographs during the past two years, while he has, at the same time, been experimenting to improve the process. It is only recently that he has been prevailed upon to take out patents. A paper on Mr. Miley's work was read before the Chemical Section at the recent meeting of the American Association in Washington by Professor W. G. Brown, and specimens of the work in its various stages were exhibited, and I am permitted to give a description of his process to the readers of SCIENCE.

Negatives are prepared by the tri-color process, using three sensitized plates and three screens, red, green and violet, respectively. For the red screen an orthochromatic plate, flowed with a cyanin solution, is used; for the green screen an orthochromatic plate, and for the violet screen a plain gelatine bromid plate. There are thus obtained three negatives, varying in density in the different areas according to the color values of the three primary colors in the corresponding areas of the object taken.

Prints are made from these negatives by the use of bichromatized gelatine pigment paper (carbon tissue). The pigment papers used are red, yellow and blue. The blue paper is printed from the red screen negative, the red paper from the green screen negative, and the yellow paper from the violet screen negative. These three printed films are then superposed upon transfer paper, the result being a color photograph, imitating the colors of the object with a marvelous degree of fidelity. This process has been used to copy oil paintings, which will probably in the future be its greatest value, as well as to reproduce flowers and fruit in their natural colors. To obtain most accurate results great care and much experience are necessary. In Mr. Miley's hands the process seems exceedingly simple. The points along which experience is most necessary, and along which also improvements may be made, seem to be the following: choice of screens so as to give the full color value of the object; corresponding choice of pigment papers to match the effects of the screens; choice in time of exposure through the different screens, so as to attain the true color value of the object; density of printing films; order of superposition of films.

While great improvements will be made in the future, the process itself can no longer be considered in its experimental stage, as it has now been in commercial use for upwards of two years. It constitutes one of the greatest advances in the history of photography.

JAS. LEWIS HOWE.

CURRENT NOTES ON PHYSIOGRAPHY.

PHYSIOGRAPHIC DIVISIONS OF KANSAS.

AN essay by G. I. Adams under the above title indicates the salient characteristics of several natural areas, and illustrates their boundaries on a map (*Bull. Amer. Geogr. Soc.*, XXXIV., 1902, 89–104). One here finds good illustration of the value and aid of physiographic explanation as a means of geographic description; the reason for this being that the relief of the state is on the whole moderate, and the elements of form hardly pass beyond the range of plain, hill, escarpment and valley, so that empirical description is baffling and confusing. The divisions proposed are all based on structure as modified by erosion and deposition. Cherokee lowland, a subsequent lowland twenty-five miles wide, crossing the southeastern corner of the state from Missouri to Oklahoma, is generally worn down to low relief on a belt of weak coal measures, but preserves occasional sandstone mounds on the divides; its streams flow in wide, flat-bottomed valleys bordered by low gentle slopes, the whole area

being 'practically down to grade.' The Osage prairies, lying next west, present a series of ragged, east-facing rock-terraces and outliers; the sinuous retreating escarpment of resistant limestones and sandstones, between which the weaker strata are worn to fainter relief. To the north, this area is blanketed with old drift, now dissected sufficiently to reveal patches of the underlying rocks. South of the center of the state is the Great Bend lowland, an extensive plain, more or less mantled with sands, close to the level of the Arkansas river, which flows through it; the plain has been eroded on weak shales, and is bordered by uplands of harder rocks. After several other areas, the High plains of the western third of the state close the essay; this division of the Great plains is described as still largely of constructional origin, its valleys being relatively small furrows when compared with the great extent of level upland remaining between them.

It is in this western and semi-arid part of Kansas that the summer traveler from rainier lands is surprised to recognize the rivers in the distance by the clouds of sand blown up from their dry channels: a peculiarity which has suggested the remark that 'one seldom sees rivers whose beds are so well aired as those of the Great plains.'

THE ALPS IN THE ICE AGE.

'Die Alpen im Eiszeitalter,' by Penck and Brückner, of which four parts have now appeared (Leipzig, Tauchnitz, 1901–2, 432 pp., many illustrations), promises to be a thorough and trustworthy monograph. The most notable characteristic of the work, as far as it is now published, is the admirably broad basis of fact upon which its generalized inductions are based. Many of these are of physiographic import. It is shown, for example, in the section on the northeastern Alps that the larger valleys repeatedly present a systematic succession of features for which glacial erosion and deposition are taken as the cause. These features are impressed upon a region which in preglacial time is believed on good reasons to have been a mountain mass of rounded forms, whose valleys opened northward upon a piedmont peneplain. Most important among the glacial features are the cirques of the valley heads, by whose excavation the subdued preglacial mountain masses were given sharp peaks and arêtes (as shown by Richter); the over-deepened main-valley troughs, with over-steepened lower side-walls and with discordant or hanging side-valleys; moraine-walled basins near where the over-deepened valleys broaden and open on the piedmont plain; groups of drumlins inside of the moraines, and extensive sheets of gravel, now more or less terraced, outside of the moraines. The repeated examples of these features, described, illustrated and mapped as occurring in orderly fashion in one valley system after another, are most instructive and convincing. Those who desire to review the work of ancient glaciers in the Alps can not do better than provide themselves with this excellent monograph as a guide for a fortnight's excursion in one of the valleys of the Tyrol.

It should be noted that these authors, and others of the same mind, have been led to conclude that large glaciers of strong slope deeply erode their valleys, not because of the discovery of any new facts regarding the erosive action of existing glaciers, but because of the unanimous testimony to this conclusion by the witnesses of glacial action in the past. Regions of extinct glaciers are unanimous in testifying to the repeated occurrence and systematic distribution of the features above named in their larger valley systems, while non-glaciated regions are equally unanimous in testifying to their absence. At the same time, well-grounded generalizations as to the normal development of valley systems by rain and rivers exclude Alpine cirques, over-deepened main valleys and hanging lateral valleys, basins, drumlins and moraines from among the possible features of such systems; while generalizations as to the modification of normal valley systems by temporary glacial action, on the assumption of active glacial erosion, logically demand the occurrence of precisely such features. Little wonder then that the theory of strong glacial erosion has found increasing

acceptance in recent years, since the unanimity of these many witnesses and the cogency of these generalizations have been recognized.

GLACIERS AS CONSERVATIVE AGENTS.

LEST the opinion in favor of strong glacial erosion should go too far, it is well to give special attention to such articles as explain by other processes the particular relation of over-deepened main valleys and hanging side valleys, to which so much prominence has recently been given in this connection. Bouney, writing on 'Alpine Valleys in Relation to Glaciers' (*Quart. Journ. Geol. Soc.*, LVIII., 1902, 690–702), recognizes the prevalently discordant relation of trunk and branch valley in certain parts of the Alps, but concludes, on the basis of 'personal examination of every part of the Alps, of the Pyrenees, the Apennines, Scandinavia, Auvergne, and many other hill and mountain regions,' that cirques are mainly the work of water; and that in a system of valleys, denudation would, on the whole, be checked where glaciers occupied the higher tributaries, and intensified by the action of torrents in the principal valleys. Garwood, discussing the 'Origin of Some Hanging Valleys in the Alps and Himalayas' (*Ibid.*, 703–715), also concludes that glaciers protect their floors. He explains certain striking examples of discordance between trunk and branch valleys in the Alps as the result of the accelerated erosion of the trunk valley on account of the steepening of its stream by a tilting of the region, while the side valleys, at right angles to the direction of tilting are not cut down, because their streams are not tilted. Kilian presents some 'Notes pour servir à la géomorphologie des Alpes dauphinoises' (*La Géogràphie,* VI., 1902, 17–26), and insists that the hanging lateral valleys of that district have been protected by glaciers while the main valleys have been deepened by normal stream work. Lugéon adduces the occurrence of rock sills that rise across certain Alpine valley floors, notably a sill known as the Kirchet in the Aar valley above Meiringen, and a similar sill in the Rhone valley below Martigny, to prove that the ancient glaciers were not destructive agents; had they been, these sills ought to have been removed; their presence is a 'peremptory argument against the deepening of valleys by glaciers' ('Sur la fréquence dans les Alpes de gorges épigénétiques et sur l'existence de barres calcaires de quelques vallées suisses,' *Bull. labor. de géol.*, Univ. de Lausanne, No. 2, 1901, 34 pp., excellent plates). This author takes no account of the hanging lateral valleys which are so abundantly associated with the main valleys of the Aar and the Rhone, and therefore naturally enough gives much importance to the rock sills, which in the theory of strong glacial erosion are explained as residual hard-rock inequalities in a much-deepened valley floor.

The manifest difficulty in the way of explaining hanging lateral valleys by the conservative action of the glaciers that once occupied them is the necessity of assuming a systematic and persistent termination of many independent glaciers at the mouths of lateral valleys, for a period long enough to allow the main stream to deepen its valley by hundreds and to widen it by thousands of feet. The difficulty in the way of accounting for over-deepened main valleys by tilting, as suggested by Garwood, is that in the plentiful examples of tilted and therefore dissected districts in non-glaciated regions, the side streams cut down the side valleys about as fast as the main stream cuts down the main valley, and by the time the main valley is well opened the side valleys enter it at grade, in most accordant fashion. W. M. DAVIS.

THE MISSOURI BOTANICAL GARDEN.

FROM advance sheets of the administrative report on the Missouri Botanical Garden, presented at the recent annual meeting of the Trustees, it appears that the gross revenue for the year was $124,431.89 and the total expenditure $119,893.84, of which $25,352.64 was spent for the maintenance of the garden proper and $8,186.46 for improvements and extensions in this department; $3,015.81 for the herbarium; $6,595.40 for the library; $5,086.67 for administrative expenses at the

garden; $1,075.81 for research; $2,874.78 for publication; $1,121.96 for the training of garden pupils (in addition to the allotment which those holding scholarships receive and which is offset by their services in the garden); $2,480.93 in carrying out bequests made by the founder of the garden; and the remainder for expenses connected with the administration and maintenance of revenue property.

In connection with a popular account of the garden, written by the director at the request of the editor of the *Popular Science Monthly* and published in the January number of that magazine, it is interesting to note that a net gain of 1584 species or varieties cultivated at the garden was made in 1902, bringing the total up to 11,551; 21,052 more persons visited the garden in 1902 than ever before recorded, bringing the total up to 112,314 for the year; the herbarium, which now includes 427,797 specimens valued at $64,169.55, was increased by the incorporation of 62,844 specimens; the library, which now includes 41,224 books and pamphlets valued at $67,506.30, was increased by the addition of 2,516 books and 2,696 pamphlets; and the current list of serial publications received at the library has been brought up to 1,160.

The effort which the administration of the garden is making to serve the three principal purposes of Henry Shaw in founding the garden, is evident from the expenditures above recorded for the maintenance of a beautiful and instructive garden; by the expenditure for the instruction of garden pupils and the support—within the provisions of Mr. Shaw's will—of the Henry Shaw School of Botany, of Washington University, in which, in addition to undergraduates, one candidate for the Master's degree and four for the Doctor's degree in botany are said to be registered; and by the expenditures for research and the publication of the results of research noted above, and the mention in the report of extensive field study undertaken by the director in connection with a revision of the Yuccas and related plants, published in the volume issued last summer.

SCIENTIFIC NOTES AND NEWS.

Dispatches from Edinburgh report that in furtherance of his educational scheme for Scotland Mr. Andrew Carnegie has decided to endow a trust for scientific research with a fund of $5,000,000.

A meeting of the executive committee of the Carnegie Institution was held at Washington on January 24. Appropriations were made exhausting the $200,000 allotted by the trustees for grants. All the research assistants have not, however, yet been appointed, and those who wish to be considered in this connection should apply in accordance with the notice published in the issue of Science for January 9.

Dr. W. A. Cannon, A.B. (Stanford University, 1899): A.M., 1900, Ph.D. (Columbia University, 1902), has been appointed resident investigator of the Desert Botanical Laboratory of the Carnegie Institution. Mr. Frederick V. Coville and Dr. D. T. MacDougal, of the advisory board of the laboratory, started on January 24 on a tour of inspection of the region west of the Pecos River in Texas, along the Mexican boundary, for the purpose of fixing upon a location for the laboratory.

King Oscar of Sweden and Norway has conferred the Norwegian medal 'for merit' on M. Berthelot, the eminent French chemist.

The Norman medal of the American Society of Civil Engineers has been awarded to Professor Gardner S. Williams, of Cornell University, for a paper entitled 'Experiments upon the Effect of Curvature on the Flow of Water in Pipes.'

The board of control of the Naval Institute has awarded the gold medal and prize to Professor P. R. Alger, U.S.N., for his essay on 'Gunnery in the Navy; Causes of its Inferiority and its Remedy.'

The Rumford Committee of the American Academy of Arts and Sciences has made the following grants in aid of investigations in light and heat: To Dr. Ralph S. Minor, of Little Falls, N. Y., $250 for a research on the dispersion and absorption of substances for ultra-violet radiation; to Dr. Sidney D.

Townley, of Berkeley, Cal., $100 for the construction of a stellar photometer of a type devised by Professor E. C. Pickering and already in use in the study of the light of variable stars; to Professor Edwin B. Frost, $200 for the construction of a special lens for use in connection with the stellar spectrograph of the Yerkes Observatory to aid in the study of the radial velocities of faint stars; to Professors E. F. Nichols and G. F. Hull, of Dartmouth College, $250 for their research on the relative motion of the earth and the ether; to Professor George E. Hale, of the Yerkes Observatory, $300 for the purchase of a Rowland concave grating to be used in the photographic study of the spectra of the brightest stars.

Dr. Nicholas Senn, of Rush Medical College, University of Chicago, is making an extended trip through the West Indies and South America.

Dr. Wherry, of the department of bacteriology of the University of Chicago, has been appointed pathologist in the Government Municipal Health Laboratory in the Philippine Islands.

From the first of January, Mr. James Gurney, for nearly forty years head gardener at the Missouri Botanical Garden, retires from active service with the title of gardener emeritus, in which capacity he will continue the experimental breeding of decorative plants, in which field he has attained considerable success.

Dr. Marcellin Boule has been named to succeed M. Albert Gaudry as professor of paleontology in the Paris Museum of Natural History.

The appointment by the council of Mr. W. L. Sclater as secretary of the Zoological Society of London appears to have caused a good deal of discussion and may not be confirmed by the fellows. In addition to this appointment it is understood that Mr. W. E. de Winton has been appointed to the new and temporary office of acting superintendent of the gardens with a view to considering questions affecting their reorganization.

The Pathological Society of Philadelphia held a symposium on snake venom at the meeting on January 22. The speakers announced were Drs. Weir Mitchell, Flexner, Naguchi, Kinyoun and MacFarland. Dr. Welch, of Johns Hopkins University, opened the discussion.

Dr. H. M. Smith, of the U. S. Commission of Fish and Fisheries, delivered an illustrated lecture before the Geographical Society of Baltimore on the evening of January 20, the subject being 'How the Government maintains the Fish Supply.'

Mr. Robert T. Hill, of the U. S. Geological Survey, who visited Martinique as representative of the National Geographic Society, and whose preliminary reports upon the St. Pierre disaster have been published in the *National Geographic Magazine, The Century, Collier's Weekly* and the daily press, is engaged upon a careful study of the scientific aspects of the eruptions and he hopes to present his views on the subject during the coming year. He is also completing a monograph on the Windward Islands for Professor A. Agassiz to be published by the Museum of Comparative Zoology of Harvard College. This work will be the result of several years of careful study of the islands and will thoroughly discuss the details of their geological structure and their bearing upon the alleged Windward Bridge and the myths of Atlantis. Mr. Hill is also busily engaged upon an extensive monograph on the Trans Pecos province of the Rocky Mountain region, which he hopes to have completed during the coming year. He has also in hand a large comprehensive geographical work upon the Republic of Mexico. From this country, where he has been gathering notes for the past fifteen years, he has just returned, after a most interesting mule-back trip across the southern end of the Sierra Madre between Mexico City and Acapulco. During the coming spring, he proposes to make a section of the Eastern Sierra Madre of Mexico, to revisit Martinique, and to spend the late summer in Europe for the purpose of continuing his comparative studies of the European and American Cretaceous faunas.

The Entomological Society of Washington has passed resolutions as follows:

Resolved, That the Entomological Society of Washington herewith expresses its keen appreciation of the great loss American science, and particularly American preventive medicine, has sustained in the death of Major Walter Reed, Surgeon U. S. Army. Although not a zoologist, he has been preeminent among physicians in making practical application of zoologic knowledge in saving human life, and his discovery and demonstration of the transmission of yellow fever by mosquitoes belonging to the species *Stegomyia fasciata* must take rank scientifically as one of the most brilliant, and practically as one of the most important discoveries ever made in applied zoology.

Resolved, also, That we heartily endorse the idea that Congress be urged to make ample provision for the support of Doctor Reed's widow and daughter. Had Doctor Reed been in private practice or on the faculty of the medical school of an endowed university, his income would have been much larger than that he received in the Army. Had he discovered some mechanical device which could in any way compare in importance, in saving lives and property, with the discovery he made in regard to yellow fever, he would have realized financial benefits which would have made him a multimillionaire, and even if Congress should vote an unusually generous pension, the sum could represent only an infinitesimal interest on the money which Doctor Reed's medico-zoological discovery will save this country and other countries.

Resolved, further, That this Society express to Mrs. Reed its sympathy in her bereavement.

Committee: Ch. Wardell Stiles.
L. O. Howard.
W. H. Ashmead.

Professor Estevan Antonio Fuertes, a distinguished civil engineer, and for many years head of the College of Civil Engineering at Cornell University, died on January 23. He had been a member of the faculty since 1873 until last November, when he retired on account of failing health. Born at San Juan, Porto Rico, on May 10, 1838, he was employed from 1861 to 1863 in the public works department of Porto Rico. He came to this country in 1863 as assistant engineer of the Croton Aqueduct Board, of which he was engineer from 1864 to 1869. He was engineer-in-chief of the ship canal expedition which the United States government sent to Tehuantepec and Nicaragua in 1870. After two years in New York city as a consulting engineer he became dean of the department (now college) of civil engineering at Cornell.

The death is announced of M. Gruey, director of the observatory at Besançon. He has bequeathed his fortune to the observatory.

The Rev. Henry W. Watson, D.Sc., F.R.S., for nearly forty years rector of Berkswell, died on January 11, aged seventy-five years. He was educated at King's College, London and Trinity College, Cambridge, where he became a fellow. He was subsequently mathematical lecturer at King's College and master at Harrow School. He is known as the author of numerous books and articles on mathematical and physical subjects, the latter being concerned with the kinetic theory of gases, electricity, magnetism, etc.

Mr. James Winshurst, F.R.S., known for his work in electricity died on January 3, aged seventy years.

M. Pierre Lafitte died on January 4 in his eightieth year. M. Lafitte had been since 1893 professor of a chair created at that time in the Collège de France for the history of science, on which subject he had long lectured, in the rooms formerly occupied by Comte whose disciple he was.

We regret also to record the deaths of Dr. Albert Hénocque, assistant director of the laboratory of biological physics at the Collège de France, and of Dr. Max Schrader, professor of surgery at Bonn, and Dr. Panas Photinov, professor of surgery at the Paris Faculty of Medicine and formerly president of the Academy of Medicine.

The Civil Service Commission will hold on March 3 and 4 an examination for the position of aid in zoology in the National Museum and on March 10 an examination for the position of aid in herpetology. The salaries of these positions are $60 and $50 a month respectively.

The Information Committee of the Engineers' Club, of Philadelphia, has arranged for an excursion to New York City on Saturday, February 7, leaving Broad Street Station on the 7:33 A.M. train. The trip will be made without expense to the members. After an inspection of the plant of the Barber Asphalt Company at Long Island City, it is proposed to visit the New York Subway, now in course

of construction, returning to Philadelphia in time to attend the regular meeting of the Club.

MR. ANDREW CARNEGIE has offered to the College of Physicians in Philadelphia $50,000 for the maintenance of its library, conditioned upon the college raising $50,000 more. Of this sum Mr. F. W. Vanderbilt has given $10,000 and Mr. Clement A. Griscom $5,000.

THE will of the late Dr. Bushrod W. James bequeaths to the city of Philadelphia a property on Mount Vernon street, all his instruments and office appliances, and $55,000 for the maintenance of 'an institution for the examination, treatment and operation of eye, ear, nose, throat, cardiac and pulmonary diseases.' His books and an endowment of $40,000 are given for the support of a free library.

The Electrical World states that the Municipal Council, of Paris, France, has voted $600 for the creation of a bureau of scientific information for foreigners. Many foreign scientific men annually visit Paris for inquiry and study in holiday times, when heads of museums, collections and libraries are away. A competent linguist has now been appointed to reply to inquiries, verbally or in writing.

THE *Scotia* of the Scottish National Antarctic Expedition arrived at the Falkland Islands on January 6.

THE New York Association of Biology Teachers will meet in the Board of Education building, 59th Street and Park Avenue, on Friday, January 30, at 8:15 P.M. The subject for the evening is 'The Public Scientific Institutions and the School System,' which will be discussed by Dr. H. C. Bumpus, director American Museum Natural History; Dr. N. L. Britton, director-in-chief New York Botanical Gardens; Dr. C. H. Townsend, director New York Aquarium, and Dr. A. G. Mayer, curator Division of Natural Science, Brooklyn Museum. The members of the Association will be glad to welcome to this meeting all teachers and school officers who are interested in the progress of nature study, as well as those whose chief concern is with high school biology.

THE national convention of delegates from the various State Boards of Health, called to consider the danger threatened by the possible introduction of the bubonic plague into the United States, was held in Washington on January 19. Resolutions were adopted stating that the presence of the plague in San Francisco has been established beyond doubt and blaming severely the gross neglect of official duty by the State Board of Health of California, the obstructive influence of the recent governor of California and the failure of the city government of San Francisco to support its city Board of Health.

NEW information regarding the coal, gas, and oil fields of western Pennsylvania, which was obtained last summer by the U. S. Geological Survey, through Mr. R. W. Stone, in cooperation with the state of Pennsylvania, is soon to be made public by the government in the form of a new geologic map, which will form a part of the Waynesburg geologic folio. The folio will include, also, descriptive text. The map will embrace a section 13 by 17 miles in eastern Greene County, and will be based upon a topographic map previously issued by the same survey, showing in detail the surface features of the region. The geologic map will be of special importance in showing the outcrops of the workable coal beds of the quadrangle. One of its most prominent features will be the representation of the geologic structure of the region by contour lines drawn on the floor of the Pittsburg coal. These contours show that the strata have been thrown into broad folds which cross the territory in a northeast-southwest direction. Since the accumulation of oil and gas is directly influenced by such structures, their accurate representation is of the greatest importance to operators searching for the productive territory. The most important fold in the quadrangle is known as the Waynesburg anticline. Upon the crest and western flank of this arch is located the Waynesburg gas field, which is one of the most important producers in western Pennsylvania. Future demands for bituminous coal will probably cause shafts to be sunk to the Pittsburg seam in many parts of this territory, in which case the structural features as shown on this map will be of great value in determining the location of such

shafts and in indicating the depth below the surface at which the coal will probably be found.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. Frederick W. Vanderbilt, of New York, has announced his intention of giving to Yale University another dormitory for the Sheffield Scientific School. Ground has just been broken for the first dormitory, which will be completed in June, 1904, and will contain fifty rooms providing for seventy-five students.

Wellesley College is to have, through the generosity of Mr. John D. Rockefeller, a new power plant. Apparatus will be installed for heating all the buildings on the college grounds, which extend over several acres, and the grounds will be lighted by electricity.

Mr. Edgar L. Marston, of New York, has founded a new scholarship at Brown University, to which he has given $5,000. The income is to be available annually for any graduate of the high school in St. Louis who may be recommended by the principal.

Mr. Frederick Jas. Quick, of Eltham and Trinity Hall, Cambridge, and of the firm of Messrs. Quick, Reek & Smith, 148 Fenchurch Street, London, E. C., has left his residuary estate to the University of Cambridge in trust, to apply the income in promoting the study of vegetable and animal biology, for which purpose the Unversity will probably eventually receive between £50,000 and £60,000.

The corner stone was laid for the new Library Building of the University of Colorado at Boulder on January 17. The central portion will be ready for occupancy on July 1, 1903. The total cost of the structure will be about $160,000.

A conference in regard to the Rhodes Scholarships of Oxford University, representing the educational interests of Massachusetts, Connecticut and Rhode Island, was held at Harvard University on January 24. Dr. Parkin presented fully the conditions. The chief subject of discussion appears to have been at what stage in education the scholar should proceed to Oxford. Committees were appointed in each of the three states to take charge of the subject.

The college entrance board is preparing its spring announcement, which will show that its work is to be considerably extended this year. Examinations have already been arranged for in eighty-six different centers in this country and Europe. Among other places, examinations will be held in Hawaii, at Ponce and San Juan in Porto Rico, London, Paris, Strassburg and Dresden. The examiners in the sciences are:

Botany—William F. Ganong, Smith College; Byron D. Halsted, Rutgers College; Edward L. Morris, Central High School, Washington, D. C.

Physics—Edward L. Nichols, Cornell; W. S. Franklin, Lehigh; Frank Rollins, Morris High School.

Chemistry—Henry P. Talbot, Massachusetts Institute of Technology; Leverett Mears, Williams College; Albert C. Hale, Brooklyn.

Geography—Albert P. Brigham, Colgate University; William N. Rice, Wesleyan; Frank Carney, Ithaca, N. Y.

Mathematics—Charlotte A. Scott, Bryn Mawr College; William H. Metzler, Syracuse University; John S. French, Port Deposit, Ind.

Rev. Langdon C. Stewardson, professor of philosophy and chaplain of Lehigh University, has been chosen president of Hobart College, Geneva, N. Y.

Professor G. N. Stewart, M.D., Ph.D., professor of physiology in Western Reserve University Medical School of Cleveland, has been appointed professor and head of the department of physiology at the University of Chicago, to fill the vacancy caused by the removal of Dr. Jacques Loeb to the University of California.

Dr. Edward C. Franklin, professor of physical chemistry in the University of Kansas, has been elected to the associate professorship of organic chemistry, in Stanford University.

Dr. Edward P. Buchner, of Clark University, Worcester, Mass., formerly professor in the School of Pedagogy of New York University, has been appointed to the chair of pedagogy in the University of Alabama, vacated by the death of Professor Jacob Forney.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 6, 1903.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE RISE AND PROGRESS OF ECOLOGY.**

THE extraordinary development of botanical science during the last decade, in which so much hitherto unknown has passed so rapidly into history, fully justifies the usual review of progress at our great annual gatherings. In following this time-honored custom I have ventured to extend the retrospect far enough to contrast some of the aspects of present-day botany with an earlier condition of the science, familiar to a few of us, though known to most of you only by tradition. The outlook, which has also come to be expected, will be limited to a single branch of the science, which has shown remarkable vigor, but the future of which is regarded by some as problematical. The reminiscences will naturally come first.

Twenty-five years ago, in one of our northern universities, a young instructor with a single assistant was engaged in the rather comprehensive task of teaching botany and 'biology.' The botany consisted in part in the analysis of flowering plants by means of Gray's 'Manual,' and in studying the minute anatomy of leaves, stems and other parts of plants, which the literary students pursued under the name of structural botany, while, with a strong

* Presidential address delivered at the Washington meeting of the Society for Plant Morphology and Physiology, December 30, 1902.

flavor of crude drugs, it was administered to the pharmacy class engaged in the study of adulterants. Then, too, there was the so-called cryptogamic botany, and, finally, the general biology, after Huxley and Martin, in which the steps of evolution from protococcus to frog were succinctly unfolded. None of the instructor's colleagues had the slightest suspicion of what it was all about, and the students—well they learned some things in spite of their environment and the teaching they got.

As for the books used—the *Centralblatt* was not in existence, but this mattered little, for neither was the enormous literature it has since recorded. The *Botanische Zeitung* was regularly published, but the library committee had no use for it, and much the same was true of most of the periodicals that every working botanist now finds indispensable; but we had Sachs's 'Text-book of Botany' and the big picture-book of LeMaout and Decaisne, and on the shelves were Sullivant's 'Icones Muscorum,' and dear old Berkeley, and Cooke's 'British Fungi,' with all their impossibilities, and last, but not least, the reports of the government microscopist, of which we can not speak particularly.

The rest of the outfit was in keeping. Microscopes, of a certain sort, there were, but no other apparatus whatever. Razors were sharpened on a well-hacked strap, iodine and sulphuric acid constituted the reagents, and the enthusiasm of fellow adventurers in an unknown country kept up the courage of young men and women who walked by faith and saw but little.

All these untoward conditions harmonized with the stage of development of the science itself. In this country there were only the laboratories of Harvard that had anything to attract special students in botany, and abroad even the laboratories at Leipzig and Bonn had little to offer compared with the magnificent work now associated with the names of Pfeffer and Strasburger; in vegetable pathology the simple methods of DeBary and Brefeld, though coupled with infinite patience and some remarkable results, gave little promise of what has since been achieved. In continental laboratories, for the most part, developmental history began with the *punctum vegetationis* instead of the egg cell. Anatomy was largely a matter of fibrovascular bundles, and the literature of mitosis was unwritten. In short, botany, as we know it to-day, was as yet only a potentiality.

The men, too, who represented the science in America, how few they were and how isolated. There were Gray and Watson, Eaton, Austin, Prentiss, Engelmann and a very short list of botanists contemporary with them who are still at work. We seldom saw one another, and we had no dreams of gatherings like these, at which the working botanists of the country are numbered by scores, too many already comfortably to hear one another talk.

Now all is changed. With the coming in of the new century the multiplied volumes of the *Centralblatt* and the *Jahresbericht* tell the story of an unequaled productiveness, and a literature which, as measured by number of periodicals, now considerably outranks that of any other science whatever.

And this literature is, much of it, widely different from that of the earlier days. Without essaying the heroic task of reviewing even the main lines of progress, I wish in passing to recall with you certain very significant changes that are taking place. First in systematic botany. You are familiar with the fact that, as the result of observations extending through some seventeen years, De Vries has recorded the actual origin of various species

of plants, 'evolved,' as he puts it, 'with a sudden leap,' not as a result of selection or the struggle for existence. It would seem that, for the species reported, the case is well within the line of positive demonstration, and that some species, at all events, arise by mutation. It is not clear that all species originate in that way, but meantime the whole question of the origin of species is thus coming more and more within the domain of direct observation. Henceforth, positive results are to be attained not by guessing, but by cultivation, and it is an inestimable gain to the science that the issue is thus clearly defined. Students who have been diverted from systematic botany because of its guess-work and its unspeakable nomenclature, have in this new way of species-making a goal worthy of attainment. It is a method that promises definite and final results in a field where hitherto 'judgment' and speculation have unfortunately, though perhaps inevitably, held sway.

The closely related field of experimental morphology, altogether unknown in earlier days, is also making a place for itself in botanical literature. The laboratory study of plastic forms has not thus far presented fully satisfactory evidence of the permanence of forms thus easily evoked, but even if no student of experimental morphology has yet produced a species demonstrably permanent, the accumulation of evidence is pointing more and more clearly to the persistence of character acquired in response to changes of environment. Thus are we coming, as it seems, to conclude that Lamarck, Darwin and De Vries have all, in their own way, gained some insight into the origin of specific characters, but that nature in the beginning took counsel of none of them, and is still working in devious though consistent ways, producing species at her pleasure, meantime laughing at our theories and our narrow range of vision.

In the matter of life histories our literature is beginning to show the inevitable breaking with the past. It has always been interesting, no doubt, to know in how many planes a new series of cell walls are formed, and at what angles and with what indication of relationship to this or that 'type,' but it is certainly encouraging to note the present tendency to ask how constant these phenomena are and what their variations under changed conditions signify.

The time is too short to speak of the phenomenal development of plant physiology since the working days of Sachs, which to a few of us seem not long ago, and of plant pathology in which we have had triumphant demonstration of what scientific spirit and method in America, now happily no longer unknown to European botanists, can accomplish. I hasten to that part of our science that is the last to make for itself a name, though it has long had a place in botanical labor and literature, namely, ecology. It has at the present time a mixed multitude of adherents, and with the double burden of a popular fad and oftentimes the cold shoulder of those who sit in judgment, if there is a survival of the name and the work it stands for, it will be because of its own inherent vitality and fitness, not because of the patronage it has received. Let us pass in review the history of this new name and what it stands for.

It is unnecessary to reproduce or even to condense the erudite etymological discussion carried on in SCIENCE a few months ago, with which, presumably, you are familiar. The word ecology has come to stay. Personally, I should have preferred bionomics, which has the advantage of indicating in its composition that living

things are its subject-matter. This latter term is at all events an acceptable synonym, and as such may properly be used as occasion requires. The question of a name, therefore, is settled and may be dismissed.

Not so, however, with the subject-matter, which represents a growth from many and various sources. The field of bionomics, in one department or another, has been successfully cultivated by Darwin, Warming, Schimper, Kerner v. Marilaun, Bonnier, Engler, Drude, Schwendener, Haberlandt and their co-workers in the Old World, not to enumerate a growing list in the United States. Some of these are known chiefly through their ecological work, others have conducted such work incidentally. In any case these names—not unworthy ones—represent ecology in their publications, much as De Bary, Sachs and Gray, for example, represent primarily morphology, physiology and systematic botany. We may, then, from their own work, better than from definition, form our conception of the subject.

To begin, as we must, with Darwin, every one knows that he was not a systematic botanist; he sent his plants away to have scientific names attached to them. Nor was he a physiologist; at any rate this was the judgment of Sachs, who ought to know. Nor yet was he expert as a plant morphologist; witness his chapter on the morphology of orchids; but he was the great exponent of ecology as it was taking form during the period of his active work and before it had a name. He, more than any other man before or since, worked in such sympathy with living things—not dried in the herbarium, nor tortured on the klinostat, nor pickled in formalin, but living, living in their own way—that they unfolded to him secrets they would tell no other, because he could understand.

The modern criticism of ecological studies seems to involve the implication that final results are only to be attained by experiment; that observation and induction are well enough, but that a plant will never tell its story correctly until it is brought to the rack. But, as a matter of fact, Darwin concerned himself chiefly with plants and animals as he found them. The record of his work is a record primarily of observation. He studied the shapes of flowers as the bees left them. Following the simple operations of the horticulturist, he observed through many generations the effects of cross- and self-fertilization. Such experiments as he performed were largely out of doors, simple or even crude, and had no part nor lot with the refinements of modern physiology. His work from beginning to end was dominated by this one great thought. He would know something of the origin of living forms as we find them. He would formulate a law not so much to express a present reaction as a habit and a history, and while aiming at the elucidation of the great problem he had set for himself, he was engaged, first and last, in studying the origin of adaptations, the study that constitutes ecology.

But there have been new phases and developments that have greatly extended the horizon of ecological study and in various respects changed its immediate object. Consider, for example, plant anatomy as De Bary left it and as it is now pursued. Dusting the volume and glancing through De Bary's great work with its treatment of primary and secondary growth, equivalent and non-equivalent members, anomalous thickenings, and more of life nature, whatever of wearied admiration may be stirred by this monumental record of indefatigable patience, one can not help feeling that it is no longer a thing of the present day. But when there came the great illuminating

principle embodying the relation of structure to function and external factors, with what eagerness even the apparently most trivial fact was gathered and pondered, instead of with the dogged sense of duty which drove us through the old anatomy. Here were spirit and life. True the disciples of Schwendener and Haberlandt, led on by the fascination of the new thought, in more than one instance have run beyond their masters in facile interpretation, but can any one doubt that the science of botany has been permanently advanced by the enlightening inspiration of the 'Physiologische Pflanzenanatomie'?

Morphological studies are coming into the same category. The methods and conclusions of Goebel in the 'Organography' have been criticised, it is true, but it may be well to consider that morphology through such work, as has been well said, is no longer the history of an idealized type, but an account of form as correlated with function and environment. Is there any question that we have gained immeasurably by the change and that this great work has materially contributed to the more scientific view? Most suggestive are recent studies of the orientation of the plant egg and its ecological significance. Surely embryology is in a more hopeful position to-day because a few daring minds have ventured beyond the limits of pure morphology and the bounds of absolute proof, and have suggested relations that may require many years to finally establish.

Still another phase of ecological study, namely, plant distribution as developed by Warming, Schimper and others, has recently come into special prominence. It involves no less than an attempt to account for the present actual distribution and association of plants, through historical and present agencies, and the response of the living organism to its surroundings. More perhaps than any other branch of biological investigation, it calls for the most varied and thorough preparation. There must be a ready knowledge of systematic botany as a working tool, at least good general training in physiology, correct morphological conceptions, and a practical knowledge of physiography. All of these added to sound judgment and conservative habits of thought are essential prerequisites to the successful study of this subject as it is now taking form.

It may be asked whether this branch of science has within itself enough to warrant such preparation and the devotion with which it is pursued by no small number of the rising generation of botanists. There can be, it seems to me, but one reply. If the labors of geologists in bringing to light, piecemeal and often with more or less uncertainty, the past history of the earth is warranted—as it is a thousandfold, whether the progress of science or industrial achievement is considered—then the critical study of this last phase of geological history, a phase which no living geologist is prepared to work out alone, fully justifies the most efficient and persistent effort that botanists trained in the manner indicated are capable of giving. Like the geologists, they are confronted with problems of peculiar intricacy, some of them no doubt insoluble, many that can never be settled in the quiet of the laboratory, others perhaps that can be settled nowhere else, all together involving work that must inevitably attract men who are more than botanists merely, who are willing to grapple with problems of many elements and more than one unknown quantity, and who know how to work patiently when results are both slow in coming and incomplete. Very few, indeed, have possessed, or are likely to possess, all these qualifications, yet some real progress has already

been made. Without attempting to review and estimate this, let us glance at some of the landmarks.

We owe to Warming, more than to any other, the conception now familiar to us under the name of plant society, which in Warming's conception included not merely a collection of plants living together, but, what the name expresses, an association of plants with mutual relations among themselves and common adaptations to their environment. The most conspicuous and useful result of Warming's work was to show so convincingly the predominant influence of water in determining plant societies that his classification, based on this as the chief factor, has been universally adopted, though, as he well knew, so simple a grouping could not serve as a permanent and complete system, however helpful it may have been in the early development of the subject.

Later the great work of Schimper brought us face to face with the tremendous difficulties to be met and overcome in attempting to account for some of the most familiar facts of distribution, but it has greatly broadened our conception of plant relations, presenting with almost the force of a new idea the fact that every plant on the surface of the globe grows where it does because conditions of air, light, temperature, water, soil and the behavior of other plants and animals—not merely in present time, but through an indefinite past, acting not alone but together, not on a lifeless thing, like clay in the hands of a potter, but on living, changing, adaptive beings—have made its presence possible. It is to such a complicated study and to problems so apparently hopeless of complete solution that the student of ecology to-day addresses himself, and it is well, perhaps, that here as in other departments of human activity, there are some daring souls who, for the very joy of treading new ground, do the work of the pioneer, without too close calculation of the probable reward.

If a personal reference may be permitted, I am glad to acknowledge my own great indebtedness to such pioneer work on the part of one of our own botanists. The study of the distribution of plants along shore at Lake of the Woods,* which appeared in 1897, has more than realized the hope of the writer that it 'might be of service in stimulating ecologic study of plants.' It could never have been written in the closet or the laboratory, however much of such labor is still required to verify or supplement the remarkable accumulation of observation and suggestion there recorded. The author has shown the practicability of tracing, here with reasonable certainty, there less perfectly, among most complicated relations, cause and effect.

If it is said that these results are too indefinite to be of scientific value, it may be answered that it is upon precisely such data that for many scores of years the practical operations of forestry have been conducted, and that on this distinctively ecological basis it has become one of the most exact industries of the age, standing perhaps next to life insurance in the certainty with which given results are attained. It is true that individual judgment is here an important factor, and allowance must be made for the personal equation, but this is also true in astronomy, one of the most exact sciences, and in perhaps every other department of human activity that is worth considering.

A still later large and increasing literature, represented by the monographs of Engler and Drude's 'Vegetation der Erde' and many other recent contributions of

* MacMillan, *Minnesota Botanical Studies*, I.

European and American botanists, is perhaps too strictly contemporary for unbiased judgment, but in any case the very mass and rapidity of its accumulation is highly significant. It is expressive of the fact that a large contingent of young and progressive botanists are reaching out far beyond the bounds of systematic botany on the one hand and the limitations of the laboratory on the other and are finding abundant opportunity for productive work.

Without at present referring to others of these more specifically, I gladly pause to do honor to the memory of the great man who, after some 'forty years of sojourn and wanderings' through the state of Alabama, presented three years ago his final contribution to the plant life of that state.* He was seldom seen in gatherings of botanists, and I have heard him lament his lack of training such as it is the fashion now to give, but he had more than the wisdom of the schools, and perhaps studied plant relations more effectually because of his comparative freedom from their traditions. Certain it is that his 'Plant Life of Alabama' has come to us as a noteworthy and acceptable contribution. Through his and similar labors, worthy, if time permitted, of special mention and discussion, the time is drawing nearer when we shall have the data for a satisfactory comparative study of the phytogeography of the whole world.

How shall such an end be attained and how can present methods be improved so as to hasten the desired consummation? Surely not, in the first place, by limiting or diverting into other directions the present output of phytogeographical contributions. All of this and much more is needed. The data for general conclusions are all too slow in coming in. This does not mean, however, that the scattering observations of every summer cruise, with half-baked notions of the 'reasons of things,' need be inflicted on the long-suffering readers of botanical literature.

There must be higher ideals, and only those who have studied, year after year, a limited area and have watched the successive changes that a few seasons bring can quite appreciate what patience and labor the maintenance of such ideals involves.

The accumulation and expression of facts as they really are should take, as it seems to me, nine tenths, possibly ninety-nine one hundredths, of the time that is being given to ecological work. Hypotheses are fascinating, but we have all erred, perhaps, in demanding that those who busy themselves with such observations shall show us promptly their bearing on a theory of the universe. At present it is really the main business of the ecological student to ascertain and record fully, definitely, perfectly and for all time the facts. He is not bound to tell us all their meaning, much as we would like to know; and furthermore, a fact once established is just as good a fact and just as likely to have an important bearing if it is ascertained in a field or garden, in the depths of the Dismal Swamp or in the Sahara, as in a university laboratory. It is just as well for science that Gregor Mendel was working out of doors forty years ago, perhaps even better than if he had known more fully the significance of his own work and had abandoned the field for the laboratory and the microscope. We need to honor more than we do the man who knows how to see living things without complicated apparatus, and we need, cheerfully and without apology to ourselves or others, to give full days of active toil to learning and telling *what is*. It is far more difficult—I speak from personal experience—after these years of laboratory supremacy, to

* Mohr, 'Plant Life of Alabama,' 'Cont. U. S. Nat. Herb.,' VI., 1901.

teach a student to critically report in decent English a direct observation in the field, than to secure from him a tabulated statement of artificially produced reactions.

And yet no true worker in science can go on with his daily task of accumulating data without at least attempting to answer to himself the insistent question 'What does it all mean?' We need and shall always need the thoughtful and original workers who give us not only 'facts well proved,' but also 'conclusions * * * deduced from facts well proved,' and we owe a debt even to those who have the insight sufficient to offer fruitful suggestion.

As a single example, may I refer to a recent paper by Paul Jaccard * in which, from a comparative statistical study of plant distribution in alpine regions, involving an enormous accumulation of data, some most interesting conclusions are drawn. It is shown that, while in the region studied there is an almost mathematical relation between number of species and variety of ecological conditions, the generic coefficient, or ratio of genera to species, is inversely proportional to such variety of conditions; that is to say, in the struggle for existence between the numerous species of a habitat, the species of one and the same genus are in great measure crowded out by species of different genera. Thus it is shown, 'in the course of a purely statistical study, that the struggle for existence works toward the elimination of like elements and selection of unlike, and that, furthermore, the resultant of a number of external factors operates as a selecting cause, not merely on the single species, but on the grouping of species, on the society.' In these studies then, the genus becomes 'a real ecological unity with a definite intrinsic value.'

* 'Gesetze der Pflanzenvertheilung in der alpinen Region,' 'Flora,' 90: 349–377, 1902.

Whether or not we accept the author's conclusions throughout, we are at all events indebted to him for an ecological study carried out with mathematical precision, from which some at least of the conclusions have been drawn with mathematical certainty. It is, to be sure, a question how far, at present, quantitative results can be looked for in this line of work, but he is not the highest type of scientific worker who demands to know at every step what he shall have for his pains. It is certain, I think, that by just such studies as those of Jaccard we shall be able through careful field work to designate and make increasingly accurate estimates of dominant factors. But many problems must necessarily be taken to the laboratory, and it is to such a union of field and laboratory work that we are to look for the rational development of ecological investigation. Ecology standing alone would present much the same anomaly as physiology getting on without physics and chemistry. But all things in their time. When one of our foremost ecologists declares that ecology must be brought more and more to a physiological basis, he states an obvious truth; it is also true, perhaps, that physiology should take rank as speedily as possible with the exact sciences and record its conclusions more and more in mathematical formulæ. These great consummations, however, are likely to require some little time, and meanwhile those of us who have not yet learned always to think in equations may, nevertheless, find much to do.

It is hardly necessary to call your attention to the need of a settled nomenclature, nor to the fact that we are likely to have a great deal more than we want when we get it. To speak plainly, it seems to the writer little short of scientific

crime to load upon willing workers a heavy burden of terminology. Far better than this, however desirable uniformity may be, in itself considered, would it be for each writer to employ, as far as possible, expressions and definitions already current in existing literature, and if forced by the nature of his work to introduce new ones, to do this as infrequently as possible.

It may be permitted to insist once more on the inclusiveness of the training indispensable to success. In phytogeography, to mention only one phase of the subject, the work must be done by the botanist rather than by the physical geographer, but nevertheless by a botanist who is sufficiently at home in physiography to read and understand what is written in the later pages of the physical development of the earth. Like the geologist he must have an instinct for following up a clue and reading history, often as dim and broken as that of some precious manuscript. He must have a conservative judgment, and yet he must freely employ hypotheses to be as freely abandoned or maintained as occasion requires. He must have the spirit of a bold explorer combined with the cautious temper of a trained investigator. He must be at home in the herbarium, but not choked by its stifling atmosphere; he must be a trained experimenter, but not near-sighted. He is aiming to see for himself and to transmit to others a faithful picture of the vegetation of the earth—or of that portion of it which he has studied—and to take account of the various factors that are responsible for what is to-day. He is a writer of history, and considering the broken record and the endless difficulties to be overcome, it must be admitted that the histories written by phytogeographers compare favorably with those that recount the rise and fall of empires.

To a student who has had this broad, thorough and deep training, and who has still a normal vision, there is an inspiring hope. If any fact is borne in upon us with the force of a demonstration, it is that at least in this corner of the universe in which we live we are certainly witnessing the slow but sure evolution of an eternal fitness of things, not realized as yet, but approaching its consummation. Misfits there are, but the exquisite adaptations we see have not always been as nearly perfect as they are to-day. Some day with more perfect adaptation, the ideal of science and the vision of prophecy will be fulfilled.

But workers in science in these days are rightly called upon to show that their work promises something besides the fulfillment of ideals. Modern science, favored as never before with the means of extension and development, should be able to justify its cost to the state by contributing to the betterment of human life. Tested by its capacity to meet this demand, ecology, I think, will not be found wanting. Agriculture, horticulture and forestry are, consciously or not, practical applications of its principles, and their best development has been attained where these principles have been most intelligently observed and applied. It is safe to predict for all these great industries a growth in our own country of which we can at present form but slight conception, and it is equally safe to say that as contributing to this development the study of ecology, now beginning to take definite and permanent form, will abundantly prove its necessity and value. It is unnecessary to remind you that the early dream of science of an exact analysis of the soil, followed by an adequate supply of lacking elements, resulting in fruitful harvests, has never yet been realized in general agriculture, nor can any such analysis, however complete, take the place of that knowledge of the plant itself, its

history, its habits and its needs, that now constitute so large a part of our study, and is an acknowledged factor in practical agriculture.

American horticulture, still more obviously a branch of applied ecology, has already reached a stage of development in which it is hardly an exaggeration to say that desired forms are actually made to order, and some of the men who are contributing to this end are leading promoters of ecological investigations. They are the men we summon when we want to know the real basis of Mendel's laws and the ones who are teaching us from their own studies the course of contemporaneous evolution.

I have already referred to forestry as illustrating the extent and definiteness of application of ecological principles in a great practical industry. It is highly important, particularly in the United States, that this relation should be well understood. We are confronted in many of our states with peculiarly difficult problems of reforestation. Land that has been the greatest source of wealth to the state is now a wilderness, practically worthless until it is clothed again with forests. How this is to be accomplished is one of the serious economic problems that the present generation is called upon to solve. We are gaining the data in part through the suggestions of professional foresters, but there is imperative need of all the light that can be gained by critical and extended study of the natural succession of plant societies. It is fortunate that such studies have already attracted earnest and capable students, and it is fair to say that those who desire to render the state a permanent economic service can hardly find a better field, providing they are fitted for the task.

I make no apology for thus emphasizing the practical value of this branch of scientific work. Service, first wrung from the unwilling slave, then the free-will offering of the citizen and patriot, is now the honorable goal of the worker in science, and there is no higher end to be attained.

Speaking for botanists, I have taken into account only one side of ecological study, that which relates to the habits and adaptations of plants. The habits of animals can not be less interesting and important, and it is a matter of congratulation that zoologists are entering this field with enthusiasm and well-defined aims. We extend to them our hearty greetings for the new year and the new era of biological work.

V. M. Spalding.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION D, MECHANICAL SCIENCE AND ENGINEERING.

TUESDAY MORNING, DECEMBER 30.

Electrical Engineering: J. Burkitt Webb, Stevens Institute, Hoboken, N. J.

Electrical engineering is a branch of engineering which more than any other joins the scientific with the practical, and bases the latter more immediately on theoretical considerations and mathematical calculations. It differs widely in this respect from some other branches of engineering, and for this reason papers which might otherwise come to this section are easily included under the head of physics, just as formerly all papers of scientific affinities went together into one section. Now, since Section D has been in existence, a paper, say, on thermodynamics, has been considered suitable for it, for although its matter was really a branch of physics, its engineering connections would naturally bring it to us. Now, Section B is overloaded with papers and I would suggest that some effort be made to get into this section such papers as may properly be claimed under

electrical engineering, interpreting it broadly if need be.

Stress: J. BURKITT WEBB, Stevens Institute, Hoboken, N. J.

Attention has often been called to the fact that in mechanics a confusion exists in the use of fundamental terms, which results in many cases from faulty definitions of the quantities employed.

Stress is one of the more recent terms, and a discussion of its meaning may lead to a better understanding of it.

An examination of authors shows that it is a general designation for tension, compression, shear, etc., in which authors agree; they differ, however, somewhat on minor points, so that the composite idea to be gained from a number of them is somewhat confused.

Its right to exist must depend upon its applicability to a definite thing in nature for which no better name exists, and we will attempt to show what this thing is.

When forces and moments are in equilibrium upon a material body, a state is produced therein which, viewed statically, is called a *stress*, and, viewed geometrically, a *strain*. Thus, if two equal and opposite forces of m pounds each, or, as we may express it, two forces m and $-m$ in the same line of action, be applied to the ends of a rope, a state of tension ensues therein. This is evident statically from its tendency to contract, and geometrically from its greater than normal length.

The following distinct points are to be noticed:

(a) It requires *two* equal and opposite forces to produce a tension, that is, it requires a 'couple,' and the definition of stress should be consistent therewith and with the following general conceptions:

A definite force applied at any point of a free body produces in one second a definite velocity of translation of its center of gravity. If a 'couple' of forces be applied, each neutralizes the translation of the other so that the center of gravity is unaffected. The forces of the 'couple' have, of course, parallel lines of action whose distance apart is the lever arm of the 'couple,' and the product of one of the forces by the lever arm is the moment, or torque, of the 'couple.' A definite torque produces a definite angular velocity, and may be neutralized by an equal and opposite torque so as to leave the body unaffected as to both translation and rotation. It is unscientific to exclude, as some authors do, from their definition of a 'couple' the case when the lever arm is zero; the 'couple' exists then as much as it ever does.

But besides these kinematic effects, which may or may not be produced, we have the static effect on the body itself, and a body can not act as the medium for balancing forces or moments without assuming a state of stress, so that a 'couple,' whose dynamic effect is reduced to zero by reducing to zero its lever arm, still causes *stress* in the body. In a 'couple,' therefore, the *essential property* of the forces themselves is neutralized, and the dynamic or static properties of the couple alone remain.

A stress, therefore, is *not* a force, any more than a 'couple' is, although appropriately measured in pounds or similar unit used for forces.

(b) Another point of difference between a stress and a force is that a force is a vector having direction, while a stress has only a line of action. This is the more evident when we consider that changing the algebraic sign of a force reverses its direction, and that to produce one stress, say a tension, we require both the plus and minus forces, thus interfering with the idea of direction. A stress has only a line of action, and changing from plus to minus has nothing to do with direction, but means

the change from tension to compression, which corresponds with a reversal of the signs of the forces producing the stress. A plus stress being tension, a minus stress is compression, with no change in the line of action.

(*c*) A stress may or may not be considered per unit of area. There is nothing in a stress to make it different from a force in that respect. All forces are actually distributed forces, and all stresses distributed stresses. A stress must be defined as to its inherent nature, and not as to a method of measuring it. Sometimes 'total stress' is required, and sometimes the 'intensity' of the stress, or stress per unit of area, just as we speak of weight or weight per cubic or square foot. That is, we may wish to speak of the tension in a beam or the tension per square inch.

An examination of authors shows the justice of these three points, although I am not aware that they have been distinctly and positively affirmed, and the importance pointed out of making them clear in defining the word stress.

A Systematic Method of Calculating the Dimensions of Dynamo-Electric Machines: CARL KINSLEY, University of Chicago, Chicago, Ill.

The dimensions are so arranged that a set of three simultaneous equations give the relations existing between the diameter of the armature, its length and the number of conductors in the winding.

These equations are primarily made to depend upon considerations which will determine the satisfactory operation of the dynamo. The *first* equation is made to depend on the electromotive force desired. The *second* equation considers the rise in temperature allowable. The *third* equation determines the efficiency of the machine.

The intermediate assumptions, such as the area covered by the pole piece, affect the ultimate dimensions, but all unite in giving the essential features desired, namely, the electromotive force, rise of temperature and efficiency.

Exhibit of a New Mechanical and Metallurgical Product: C. A. WALDO, Purdue University, Lafayette, Ind.

The new product was shown in two forms. A thin spherical shell two and one half inches in diameter, with a hole one eighth inch in diameter through it, and a reproduction in thin sheet copper of a common quart whiskey bottle. Both products had neither seam nor weld and were not made by electro-deposition. This is accomplished by a new process not yet made public.

Comparative Ductility of Steel under Gradual and Impact Loading: W. K. HATT, Washington, D. C.

This note describes the results of tests to determine the effect of rapidity of deformation in tension on the ductility of steel. Bars were tested: (1) Under a gradual loading of about ten minutes' duration, and (2) under one blow of a falling weight, causing rupture in from .01 to .05 of a second. The tests cover a range of steel from soft steel castings and boiler steel to hard tire steel. The material was all of good quality.

It is evident from the results that an increased ductility may be expected under impact conditions in the case of soft steel. There seems to be a tendency under impact to develop nodes of ductility in tension bars, and sometimes two or even three distinct necks are formed. This may account for the observed increase in ductility. The phenomenon may be explained by the assumption that the harder portions of the bar transmit the shock quickly, throughout the region that they occupy, to the softer

parts where the shock is absorbed in producing deformation. The effect of low temperatures, for instance, is to elevate the elastic limit of steel, *i. e.*, to convert it, from the mechanical standpoint, into a harder steel; and when a bar that is partly frozen is broken in tension the frozen section suffers but little deformation under impact, while the other segments are stretched to the point of plasticity.

In case of harder steels, the indications are not so evident. It is difficult to obtain two bars cast from the same heat of steel that are of the same grain, and comparisons of individual bars are apt to be misleading. In general it may be said that the ductility under impact of hard steels may fall below that under gradual tests depending on influences not understood. There are differences of ductility under impact not detected by the gradual test.

Nicking the surface of a bar renders it less ductile under an impact test than under a gradual test. The shape of the cross-section and condition of surface have a minor influence. In the case of both hard and soft steels the ductility is greater when the bar is broken by a number of blows than when broken with one blow. Within ordinary limits the speed of delivery of a given amount of energy at one blow has no appreciable effect on the ductility. Low temperatures decrease the ductility more decidedly under impact than under gradual loading.

Cementation of Road Material and Elasticity of Clays: Allerton S. Cushman, Bryn Mawr College, Bryn Mawr, Pa.

The method of testing the binding or cementing power of road materials was briefly described. It was pointed out that the cementing value was a phenomenon of the same nature as the plasticity of clays. Results obtained in the road material laboratory of the Department of Agriculture, seem to point to the fact that plasticity is dependent on a colloid condition of the particles. No sample has ever been met with that exhibited plasticity that did not contain water of combination, although many samples which contain water of combination do not exhibit plasticity. Only one sort of water of combination (the so-called Micellian water of Nageli and Van Bemmelen) is in any way a measure of plasticity. The inorganic colloids or so-called 'hydrogels' have been studied by Van Bemmelen. They are chiefly characterized by the peculiar structural relation they bear to water. They can be hydrated and rehydrated indefinitely unless by heating to too high a temperature the colloid structure is destroyed. Exactly the same phenomenon characterizes plastic clays and rock powders. The surfaces of roads are continually being powdered by the effect of traffic wear and weathering, and the particles are continually being cemented and recemented. If the material of the road lack plasticity the particles blow and wash away too rapidly. The binding quality of such rocks as limestones and dolomites is a function of the hydrogel impurities present usually either in the form of silicic acid or hydrated oxide of iron.

Topographical Work, U. S. Geological Survey: H. M. Wilson, Washington, D. C.

A verbal description of recent topographic work done by the U. S. Geological Survey, the extent of the same as far as completed being shown upon a map of the United States.

TUESDAY EVENING, DECEMBER 30.

Construction of Washington Monument and Library of Congress: Bernard R. Green, Washington, D. C.

A description of the construction of the

monument, illustrated by a series of photographs.

Rapid Primary Triangulation: John F. Hayford, Washington, D. C.

This paper is a statement of the results secured by a triangulation party on the 98th meridian triangulation in Kansas, Oklahoma, Indian Territory and Texas, during the season of 1902, and of the peculiarities of their methods. This triangulation is fully up to the primary standard degree of accuracy, and it is believed to be the most economical as well as the most rapid triangulation of its class yet executed.

Reaction versus Velocity as an Active Agent in Removing Bars: Lewis M. Haupt, Philadelphia, Pa.

Necessity for channels of larger capacity across ocean bars, to keep pace with the growth of vessels and commercial demands. Present resources of the engineer limited to concentration and dredging. Defects of this system, with illustrations.

Reaction, the cause of deep holes and channels, rather than mean velocities. Eddies which scour and those which deposit. Applications of reaction, as exemplified in nature, to effect similar results locally across ocean bars, illustrated. Great economy and efficiency of the single-reaction breakwater as compared with other methods in vogue.

WEDNESDAY MORNING, DECEMBER 31.

Notes on Comparative Designs of Metallic Arch Bridges: H. S. Jacoby, Cornell University, Ithaca, N. Y.

A comparison of the weights of three-hinged spandrel-braced arches for different heights of the crown hinge, ranging from the bottom to the top chords. The effect of variations in bridge specifications upon the weights of two-hinged arch ribs and spandrel-braced arches. The effect of different curves for the lower chord.

Road Material Laboratory: L. W. Page, Washington, D. C.

This paper describes different road-making materials and points out the wisdom of having them tested by laboratory methods before they are used in construction. The amount of traffic on one road may not require the same kind of material that another road should receive. The binding materials present with crushed rocks of various kinds have much to do with their value for surfacing roads. The road-material laboratory of the Agricultural Department makes these tests free and invites an inspection of the equipment and methods used in the examination of road material.

Agricultural Engineering: Elwood Mead, Washington, D. C.

Conditions of farm life and farm labor in the United States have undergone a revolution in the past fifty years. The shorter hours of labor and conditions of life in factories are having their influence on farm work. The farmer is compelled to do as the factories have done, substitute power for hand labor and use the most effective implements and machines. Application of power to farm work is taking new and significant form through the use of steam, gas and electricity as substitutes for animal power. Increasing importance of this evolution has attracted the attention of European countries, where institutions for the study and improvement of farm machinery are supported by the state.

The agricultural colleges of this country have in recent years given serious attention to this subject. A committee on methods of teaching agriculture has formulated a course in the subject which has been published in Bulletin 45, on pages 6 and 7, of the Office of Experiment Stations. One difficulty confronting the colleges is the lack of classified and verified information.

The interest shown in this subject shows that the time is ripe for further action.

The Mechanical Problems of a New Ore-producing Territory: C. A. WALDO, Purdue University, Lafayette, Ind.

A recently discovered copper and silver district in the Pan-Handle of Oklahoma is thirty miles distant from railroad transportation. The problem is to secure power to concentrate the ore at the mine. Electric power generated by the water of a stream twenty miles distant may be used, or gas engines adapted to the use of Texas oil may be more practicable.

The Metric System: J. BURKITT WEBB, Stevens Institute, Hoboken, N. J.

The advocates of the metrical system are pushing it more than it is worth. If its opponents would get up a *system* of their own there would be less chance of its success. Its main advocates are scientific rather than practical men, who make use of the less important parts of the system.

Taking up these points in reverse order, we remark that the less important part of any system of weights and measures is that which this designation indicates, with measures restricted to those of capacity. Measures of length form the most important part of any system. Measures of quantity and weights of different kinds often exist, and are in common use together without difficulty, though in scientific work involving accurate calculations trouble may result. Now, those who advocate a legal compulsory introduction of the metrical system are mainly interested in this end of it, and have little idea of it from the other and more important one. Standards of length lie at the foundation of all our important and accurate manufacturing and engineering work, and an examination of the necessities of this work, in both its theoretical and practical parts, shows that a change to the metrical system would be not only very expensive, but detrimental. It is difficult to estimate the cost of a change from the inch, with its multitudinous ramifications throughout the mechanical world, to metrical units; it would be enormous, and what advantages has metrical measure that the inch may not have, and much more? As to the size of it, the meter has nothing better to offer; and as to its subdivisions that into sixteen parts is far better that that into ten, except for certain purposes of calculation, and here the right thing to do is not to change to ten, but to so improve calculation by sixteenths as to make it also better than reckoning by tenths. This leads to the next point, or that of a system of calculation by sixteenths which shall be superior in all points to that by tenths.

The doubts that one may have as to the possibility of this are illusory, and mainly founded on the mistaken idea that the advantage of the so-called decimal system has anything to do with the number ten. 'Decimal' is a misnomer. 'Digital' would be quite as good, but neither touches the system itself, which consists in the values of the consecutive places, units place, tens place, etc., being in geometrical progression. The system would exist and have its characteristic advantages with any number as the ratio of this progression.

Now, sixteen is in many ways a better number than ten, and the change to a system having sixteen as its ratio or root would be such a change as a Chinaman has to make in adopting a European language with its methods of writing and printing and reckoning. A Chinaman might not understand if he were told that his language was inferior, say, to German, any more than a devotee of the meter can see that his idol is at most a poor stick lacking in the proportions needed for common measurements.

The next or first point follows from this,

which becomes clearer as the matter is further examined, and the peculiar collateral advantages of sixteen are appreciated. To do this fully will require another paper, but some of them may be mentioned in the hope of eliciting comment and discussion.

The Drainage Problems of Irrigation: C. G. Elliott, Washington, D. C.

A new problem confronts the owners of irrigated lands. The leakage from canals, and over-irrigation by users of water, have destroyed the productiveness of land by producing saturation of soils in certain localities, and resulting alkali conditions. Well-directed drainage operations will reclaim such lands and protect those which are threatened with the evil.

Second Law of Thermodynamics: J. Burkitt Webb, Hoboken, N. J.

Various attacks have been made on this second law, and in a recent one by Jacob T. Wainwright, of Chicago, of which I shall not attempt a full criticism, there are some peculiarities, two of which may be worthy of remark.

In the first place the writer seems ignorant of, or avoids, Rankine's work in this direction, which, to my mind, contains the best statement and proof of the law, in no way touched by his remarks.

The proof is like a nutritious nut—crack the shell, or, failing that, gnaw through it, and you have a perfect kernel, the living germ of the second law, from which so much valuable fruit has sprung.

The simplicity of the proof makes the nut hard cracking for some. He holds that evidently heat is of such a simple, homogeneous nature that all its differential elements must have the same effect, and, further, that all the infinitesimal elements of temperature must have equal effects, which last is analogous to the statement that when the camel's back breaks each element of weight has the same effect—the first straw being equal with the last in the actual catastrophe. From this the division of each element of heat by its absolute temperature and the second law follow easily.

Secondly, the author's claim that Clausius's proof is faulty (as I pointed out years ago) is correct. Clausius proves the form of his function on the principle that in a reversible cycle all natural working substances must be equally efficient, and then attempts to define the function exactly by discussing the properties of a perfect gas—a theoretical working fluid which does not exist in nature. The proof, therefore, fails in default of a further investigation showing that the absence of the natural properties which a theoretically perfect gas lacks does not vitiate the result.

Theory, Construction and Use of a Pressure-tube Anemometer: A. F. Zahm, Catholic University, Washington, D. C.

The present paper describes the design and use of a pressure-tube anemometer whose observed readings conform to those required by theory. The instrument consists of a double-pressure nozzle connected with a differential pressure-gauge. One nozzle transmits the direct impact of the air, while a side nozzle gives the static pressure of the current at the same point. Their difference is theoretically proportional to the velocity-head, and serves to determine the velocity of the air when its density is known. To prove the agreement of the theoretical and actual pressures sustained by the nozzles, the following facts are experimentally established:

(1) The pressure on the direct impact nozzle is proportional to the total head; (2) the pressure on the side nozzle equals the true static pressure of the point; (3) the differential pressure is proportional to the true velocity head, since the velocity

calculated therefrom equals the known velocity of the air; (4) the differential pressure varies exactly as the square of the velocity, as required by theory. The air velocities employed ranged from five to thirty miles an hour, and the pressure gauge was graduated to millionths of an atmosphere. The experiments were conducted in a tunnel through which air was drawn with uniform velocity and direction, its velocity being measured simultaneously by the pressure-tube anemometer and by a balloon anemometer. In the latter device a toy balloon drifting through the tunnel cuts two pencils of light thrown squarely across its path at an interval of ten feet, the time between the cutting of the sheets of light being determined photographically. The average wind-speed determined by means of the pressure-tube anemometer agrees with the average determined by the standard, or balloon anemometer, accurately to less than one per cent. Examples are also given of the use of the pressure-gauge for measuring static pressures from one millionth of an atmosphere upwards.

Hydrographic Work of the U. S. Geological Survey: H. A. PRESSEY, Washington, D. C.

The work of the Survey in measuring the flow of all the important streams in the country is described, and the great value of the results to industrial projects pointed out.

Friction in Ball-bearings: M. J. GOLDEN, Purdue University, Lafayette, Ind.

The paper describes an apparatus used to determine the friction of ball-bearings of different sizes at different speeds. It was shown that at high speeds ball-bearings fail entirely. Ball-bearings for ordinary pressures and speeds give a loss by friction less than that of an ordinary bearing poorly lubricated, but not much less than a finely polished and thoroughly lubricated bearing.

Errors in Analyses of Furnace Gases Shown by Computation: WILLIAM KENT, Passaic, N. J.

It is shown by arithmetical computation based on the analyses of a certain coal that the analysis of the gas from the chimney, as reported by the chemist, must be in error. With such an analysis it is impossible to compute a heat balance in a boiler test with any approach to accuracy.

Heat Exchanges Within the Steam-engine: R. H. THURSTON, Cornell University, Ithaca, N. Y. (Not read.)

The method of heat exchange in the steam-engine cylinder, which results in serious wastes of heat and proportional reduction of the efficiency of the machine, has been considered an obscure phenomenon. The experiments made by Professor Dwelshauvers-Dery and by M. Duchesne indicate that the cylinder wall takes the temperature of the steam as long as it is covered with moisture; but when the wall is dry it may hold a temperature considerably in excess of that of the steam in contact with it. During expansion and compression of steam in the cylinder there is a constant interchange of heat, which accounts for the varying efficiency of the steam as a motor. Experiments conducted at Sibley College of Cornell University sustain these deductions. The experiment is described and results shown graphically.

ELWOOD MEAD,
Secretary.

SECTION E, GEOLOGY AND GEOGRAPHY.

SOME forty-five papers were offered to Section E for reading at the Washington meeting. On account, however, of the conflict with the meeting of the Geological Society of America, all the papers of the Section E program were accepted by the

Geological Society for reading before that body as a part of its program, with the exception of five which were read before Section E Monday afternoon (there being no vice-presidential address this year), and the papers dealing with the Lesser Antilles and the recent eruptions there, which were read before the same body Friday morning, the Geological Society adjourning at that time for the purpose of attending the meeting of Section E.

The Shifting of Faunas as a Problem of Stratigraphic Geology: Henry S. Williams, Yale University.

A comparison of sections through the Upper and Middle Devonian rocks of the New York-Pennsylvania province discloses marked differences in the faunas which occur at corresponding levels. The explanation of the facts is found in the shifting of faunas during the time represented. The paper discussed at length the nature, extent and mode of recognition of faunal shifting in studying stratigraphy, and modifications were suggested in the customary practice of correlating formations by their fossils.

Some Relations of Tertiary Formations of the Northern Great Plains: N. H. Darton, U. S. Geological Survey.

For several field seasons, the author has given a portion of his attention to the formations from Oligocene to Pliocene in age of Nebraska, South Dakota and eastern Wyoming and Colorado. Structural and stratigraphic relations have been determined, and the origin and geologic history of the formations have been considered. In studying the Black Hills, Big Horn Mountains and Laramie range, it has been found that there are extensive overlaps of the White River Oligocene beds to high altitudes where there are old shore lines which define some of the physiographic conditions. The materials of the formations have been deposited principally by streams, but at some points fine-grained materials have been laid down in widespread overflows or in local lakes and bayous.

The Economic Geology of Michigan: Alfred C. Lane, Lansing, Mich.

The author defines economic geology as the science of raw materials. The effect of the presence of these materials upon industry and the effect of geological conditions upon their development were illustrated by reference to several Michigan products. Such factors were considered as the position of the state in the center of the Great Lake distributing system, the tilting of the Great Lake basin and its effects, the mutual relations of coal and iron and the development of the iron-ore business, the peculiarities of lake copper as compared with that of the far west. Salt, limestone and lumber and their mutual relations, the coal basin and the causes of its retarded development, were considered.

Some Results of the Lake Minnesota Geological Survey: N. H. Winchell, Minneapolis, Minn.

This paper mentioned: (1) Some of the scientific conclusions, and (2) some of the known economic results of the Survey presented in the final report. (1) Scientific: (*a*) The identification of the parts of the Upper Cambrian, (*b*) the definition of the Lower Silurian, (*c*) the determination of the extent of the Cretaceous toward the east, (*d*) the definite determination of the duality of the ice epochs, (*e*) the determination of the duality and alternation of the ice lobes and the resultant glacial lakes, (*f*) the discovery of the duality and later of the triple character of the iron horizons of the Lake Superior region, (*g*) the separation of the Archæan into two non-conformable parts, (*h*) the discovery

that the Animikie overlies both parts of the Archæan non-conformably, (*i*) the recognition of the igneous origin of the green-sand of the Animikie, (*j*) the determination of the igneous origin of the jaspilytes of the Mesabi and Vermilion ages, (*k*) the addition of numerous minerals to the geographic area of the state, (*l*) the determination of the metamorphic origin of gabbro from Archæan greenstone, and (*m*) of granite from Archæan sediments. (2) Economic and educational: (*a*) Determination of the cause of foul waters in the prairie region, (*b*) the demonstration of the excellence of the Hinckley sandstone and its consequent wide adoption, (*c*) the discovery and announcement of the Mesabi iron ores, (*d*) the distinction of the gabbro (igneous) ores from the Mesabi iron range, (*e*) the delineation of the Mesabi belt as distinct from the Vermilion, which has facilitated search and exploitation, and (*f*) the demonstration of the utility of intrusting geological surveys to the state universities.

Current Work in Paleontology in New York State: John M. Clarke, Albany, N. Y.

(*a*) The Guelph reefs and their faunas. Recent investigations have shown an excellent development of the Guelph fauna at at least two stages in the Upper Siluric dolomites of New York, and an analysis of the character of the species and the nature of the enclosing rock indicates that the fauna flourished on and about coral reefs in the shrinking sea. (*b*) The faunistic provinces of Portage time. In addition to the provinces already established during this stage in New York, viz., the eastern or Oneonta, the central or Ithaca, the third or Naples (= true Portage). The last proves to be divisible into sub-provinces, depending upon the degree to which this fauna, advancing from the west, penetrated eastward. The migration path of the fauna is from the northwest. (*c*) The causes of depauperation in pyrite faunas. Investigation of the organic contents of the sheet of pyrite lying in the horizon of Tully limestone for a distance of one hundred miles in western New York gives some clue to the causes which have effected like results in similar occurrences of other age. (*d*) The determination of the uppermost Cambric in eastern New York. This pertains to the discovery of the horizon of *Dictyonema* and *Clonograptus* in Rensselaer County.

On an Important but not Well-known Locality Furnishing Cretaceous Fishes: O. P. Hay, American Museum of Natural History.

The paper called the attention of geologists and collectors to a locality in the region about Yankton, South Dakota, from which Dr. F. V. Hayden obtained several species of fossil fish for Professor E. D. Cope. Most of the genera are related to or identical with genera from Mount Lebanon, Syria.

Quantitative Chemical-mineralogical Classification of Igneous Rocks: Whitman Cross, J. P. Iddings, L. V. Pirsson and H. S. Washington.

The presentation of the subject embraced a statement of the needs and the occasion for such a classification of igneous rocks; the principles on which it is based; the method of procedure employed to produce quantitative subdivisions of rock magmas; the method of expressing the actual mineral development (composition) and texture of the rocks; the nomenclature proposed; the proposition to establish a classification and nomenclature for use in field work, and for general geological purposes. The presentation closed with a correlation of the quantitative classification with the one in use at present.

Dikes in the Oklahoma Panhandle: C. A. Waldo.

In this paper the author referred to the discovery of mineral dikes in the extreme northwest townships of Oklahoma Territory. This section has not been carefully mapped by the U. S. Geological Survey, and it is a region about which little has been written. The discovery of the dikes resulted from an attempt to explain the existence of extensive mineral deposits in that locality, and was accomplished after the failure in this particular of several experts and hundreds of professional mineral prospectors.

The Geographic Development of Western Pennsylvania and Southern New York: Marius R. Campbell, U. S. Geological Survey.

His study of the upland features of western Pennsylvania and southern New York has satisfied the author that this plateau is not as old as the deeply dissected upland of the bituminous coal field of West Virginia and Kentucky. The latter is generally regarded as of Cretaceous age; therefore, the former must date back only to some part of the Tertiary. In reviewing the work of Professor Davis in the eastern part of the state, the author finds evidence of a peneplain intermediate in position and age between the Schooley (Cretaceous) and the Somerville (Tertiary) peneplain. This newly-recognized feature is called the Harrisburg peneplain, from its extensive development in the belt of shale hills back of that city. It appears that from whatever point this peneplain is traced it rises toward the New York line, and the author has provisionally correlated it with the general upland tops already mentioned in the plateau region of northern Pennsylvania and southern New York. If this correlation is correct, the peneplain has been deformed into an ellipsoidal, dome-shaped structure whose major axis extends in a northeast-southwest direction, and whose maximum development is attained in Potter and McKean Counties, Pennsylvania.

The Blue Ridge of North Carolina: William Morris Davis, Harvard University.

The Blue Ridge in northern North Carolina and southern Virginia is not properly a ridge with strong slopes descending on either side of its crest line, but it is an escarpment separating an uneven and often mountainous upland on the northwest from a rolling and occasionally mountainous lower land on the southeast. The escarpment is not determined by variation of structure in the disordered schists in which it is carved, but by the unequal length of the rivers which drain the upland back of it in the northwest and the lower land in front of it on the southeast. The high level head-waters of the northwestern rivers, which discharge *via* the Mississippi into the Gulf of Mexico, are constantly losing length by the retreat of the escarpment through the retrogressive erosion of the low level head-waters of the shorter Atlantic stream. There is no local indication that the sea has had any share in producing the escarpment.

The Fresh-water Tertiaries at Green River, Wyoming: William Morris Davis, Harvard University.

This paper gave an account of some detailed observations on the stratigraphy of the Tertiary strata at Green River, showing the occurrence of variable deposits, including frequent cardboard shales, alternating with cross-bedded, ripple-marked sandstones and with occasional shale-pebble beds. An inquiry into the nature of strata deposited in large lakes and on the stream-washed surface of interior basins

leads to the conclusion that the Green River Tertiaries are not simply the continuous deposits of a single large lake, but that they are the deposits of many successive shallow and fluctuating lakes of moderate area combined with the deposits of numerous aggrading streams.

A Highly Viscous Eruption of Rhyolite: G. K. Gilbert, U. S. Geological Survey.

A butte of rhyolite in western Utah illustrates the viscosity of acid lavas, and thus helps to sustain the theory of Dutton for the dynamics of eruption.

Physiographic Belts in Western New York: G. K. Gilbert, U. S. Geological Survey.

The physiographic belts recognized by Lincoln can now be studied in part with the aid of contour maps. South of the drumlin belt is a zone of great glacial erosion in which the aspect of the land was revolutionized by ice sculpture. It is limited southward by a great moraine, beyond which the upland drainage is pre-glacial, and in which the glacial modification of hill forms diminishes rapidly to the glacial boundary.

Some Shore Features of Lake Huron: M. S. W. Jefferson, Ypsilanti, Mich.

This paper reviewed the shore features, such as dunes, beaches old and new, town sites and river erosions, at Kincardine, Ontario, with regard to Kincardine's position nearly 100 miles north of Gilbert's isobase line. Comparison was made with points to the south of the same line, as Muskegon. Kincardine is regarded as possessing a lake and bar separating it from Lake Huron, modified in a manner appropriate to an uplift of the smaller lake bed to a height of about 70 feet above the great lake, with resulting elevated beaches, deeply cut stream valleys, limited dune sand and increased river sediments.

The Topographic Work of the Geological Survey in Northern Canada: Robert Bell, M.D., Acting Director Geological Survey Department, Ottawa.

Previous to the confederation of the Canadian provinces in 1867, and the subsequent acquisition by the Dominion of the other British possessions in North America, including British Columbia, the territories of the Hudson Bay Company, the Labrador peninsula and all the islands lying north of the mainland of North America, the operations of the Canadian Geological Survey were confined to the southern parts of the areas which now constitute the provinces of Ontario and Quebec. Since confederation, however, the attention of the department has been directed to surveying these vast, newly acquired territories and the regions which have been added to Ontario and Quebec. These tracts were entirely unsurveyed and only partially explored, the main geographical features alone being roughly indicated on the maps. The subdividing of the fertile lands of Manitoba and the Northwest Territories was performed by a different department, and its work added little to the knowledge of the topography of the country. The fieldmen of the Geological Survey have been the pioneer surveyors of the natural features of the vast regions which constitute half the continent. In order to map out the rock formations, the geologists found it necessary to make topographical and geological surveys simultaneously. From their long experience in these operations, they have been able to do this work rapidly and well, and the object of this paper was to show the astonishing amount of accurate geographical work which has been accomplished by a small number of devoted men with very limited means at their disposal.

The Saddle-back Topography of the Boone Chert Region, Arkansas: A. H. PURDUE, University of Arkansas.

The rocks exposed in northern Arkansas are those from the Silurian to the Upper Carboniferous inclusive. The position of the rocks is essentially horizontal. In the western part of the region north of the Boston Mountains, the prevailing surface rock is the Boone chert; but in central northern Arkansas erosion has continued far below the Boone chert, exposing the Silurian rocks, except where there are monadnocks. These monadnocks are of necessity greatly dissected by small mountain streams which are cutting their way headward into them. The spurs between these streams are frequently surmounted by one or more knobs, which produce the saddle-back topography so common in the region. These knobs are always capped by fragmentary Boone chert, which in some cases is partly water-worn. That the water-worn material is not due to submarine action is proved by the fact that it is found only locally. It follows that it must be of stream origin.

The knobs owe their existence to the formation of alluvial cones by former streams at the time when the stream beds were on the level of the present knobs. The cones of the fragmentary chert obstructed the streams, causing them to shift laterally, and at the same time protected the subjacent rocks from erosion. If conditions were favorable, two or more cones were formed by the same stream at different stages in its history, a knob resulting from each cone, and a series of knobs indicating the former course of the stream. The paucity of the water-worn material in these old cones is explained by the streams that formed them having been short and of a torrential nature. The present drainage of the region is like that at the time the Boone chert was the prevailing surface rock only as regards the master streams; and the change is due in a large measure to the shifting of the streams brought about by their own obstructions.

Scientific Relief Maps: GEORGE CARROLL CURTIS, Boston, Mass.

For years past the scientific bureaus of the United States have deemed it advisable to construct relief maps. The Paris Exposition of 1900 afforded a just international comparison; and it was found that America was exhibiting work which fell far behind that of some of the European countries, because of the lack of scientific methods.

A perfect topographic relief map is a perfect miniature or model of nature; and, unless natural laws and principles are employed in its construction, no progress beyond the old relief map will be attained. Truthful topographic modeling is an exact art requiring accurate, rational and systematic methods throughout the gathering of data upon the field, and the application and reproduction of the facts of nature in other dimensions. Modern scientific inventions, including contour maps and dry-plate photography, are aiding in bringing this work toward perfection and into recognition.

Lunar Calderas: E. HAYES, Wellesley College.

Every topographic feature of the moon is invested with mystery and difficulty. Some forms, however, invite study and discussion, because of their likeness to certain earth forms. Among these are the so-called 'ring-plains.' They consist of a circular wall, composed often of lofty mountains enclosing an approximately horizontal floor which is generally broken by a central cone. The prevailing theories of their formation are untenable, for both dynamic and topographic reasons. On

comparing such a ring-plain as Theophilus, for example, with the Hawaiian calderas studied by Dutton, we are led to assign to these lunar rings an origin similar to that of terrestrial calderas.

Evidences of Post-Newark Normal Faulting in the Crystalline Rocks of Southwestern New England: WILLIAM H. HOBBS, University of Wisconsin.

The study, in 1899, of the Newark area of the Pomperaug valley in Connecticut disclosed conditions of deformation which have made it possible to work out, in part at least, the structure of the crystalline rocks surrounding the Newark basin. The key to the structure has been sought and, it is believed, found in these areas where the areal relations seem most complex, or where, in other words, a large number of formations are found in small masses within a very limited area. Such areas of complex areal relations have generally been regarded as ill-adapted for structural studies. They have also been generally neglected for the reason that the determination of their structure would be time-consuming, and, when once determined, could hardly be represented upon geological maps of the ordinary scale. The studies here under consideration have shown that, complex though they may be, the very complexity of these areas will generally allow of but one theory of their structure, provided the data collected are sufficiently complete. On the other hand, areas of the crystalline rocks in which formations are represented at the surface by large masses are apt to allow of a number of theories of interpretation, any one of which may furnish an adequate explanation of the facts observed. It has been by the detailed study of a number of widely separated areas of excessively complex areal relations that the conclusions here stated have been reached.

It was shown that the area of southwestern New England is one of complexly jointed and faulted, as well as of complexly folded, rocks. The system of faults affecting the area is found to be oriented like the system of joints. The throws along fault planes, while generally small, are, owing to the great number of faults involved, by their cumulative effect of great importance. Methods have been developed by which the *fault system* of an area may, under favorable circumstances, be determined from observation in the field.

A Record of Post-Newark Depression and Subsequent Elevation within the Area of Southwestern New England: WILLIAM H. HOBBS, University of Wisconsin.

Within a belt some twelve miles in length, lying between Sheffield, Mass., and Falls Village, Conn., there are revealed some peculiar conditions of the impregnation of dolomite by silica. The trunk lines for the introduction of the silica are shown to be a system of joint- and fault-planes clearly connected with the Post-Newark deformation of the area. Evidence is not lacking that surface conditions widened the joint fissures previous to the infiltration and cementation by silica. A measure of time is thus secured within which the cycle of subsidence, cementation and elevation, must have been included.

Criteria Requisite for the Reference of Relics to a Glacial Age: T. C. CHAMBERLIN, Chicago University.

What constitutes good grounds for referring relics (human, in particular) to a glacial age, and the chief sources of error in making such reference were discussed under the following sub-topics: Evidence to be sought in the glacial formations themselves; evidence from the bowlder clays; evidence from assorted drift included in till and moraines; evidence from

kames and eskers; confirmatory evidence in these cases; combined evidences; the cumulative value of repetition; the interpretation of imbedded and striated relics; evidences from the interglacial deposits; evidences from assorted drift lying upon or outside of the true glacial series, river deposits especially; scour-and-fill; unequal effect on aggrading and degrading rivers; breadth of action in the great streams of the glacial area; adjustment plains as sources of deception; amount of the errors; flood-plain deposits; bluff-border accumulations; derivative formations; decomposed secondaries; the meaning of a principal river as a cause of alternate erosion and deposition in the mouth of its tributary valleys, and association with certain extinct animals not a criterion.

Glacial Cirques and Rock-terraces on Mount Toby, Massachusetts: B. K. Emerson, Amherst College.

Mount Toby is composed of coarse Triassic conglomerates, and, being placed in the lee of the great ridge of the Deerfield trap-sheet, has been especially protected from the erosive action of the inland ice of the glacial period. The mountain is now cut into deep amphitheaters with strong, often vertical walls which head against an extremely narrow ridge, and are separated by ridges which are crossed by many vertical rock-terraces from ten to a hundred feet high, most of which seem to be formed by the plucking action of the ice. They do not cross the cirques, which are deeply filled with foreign glacial material. They seem to have been formed by small glaciers, and then overridden and filled by the main ice-sheet.

Protection of Terraces in the Upper Connecticut River: C. H. Hitchcock, Dartmouth College.

Recent papers by Professor W. M. Davis propose the theory that many alluvial terraces are kept in place by underlying ledges. First, the high flood-plain was deposited by the river, enormously developed through melting of the ice-sheet. Next, as the waters diminished in volume, a large excavation was made in the high plain, and the steep slopes resulting are the escarpments of terraces. These terraces are variable in bulk and number, and it has been a difficult matter to explain these variations. As the river swings back and forth over the low ground, it meets ledges which it is unable to remove; neither can it remove the earth superimposed upon them. In other words, the ledges protect the terraces behind them from destruction. It is common to see a ledge at the extreme pointed end of a terrace, and the terrace broadens as you follow it back. The outer edge below the ledge will ordinarily be curved. The localities described by Professor Davis are at Westfield, Mass., and Bellows Falls, Vt. I have extended the observations above that point, especially between White River Junction and Wells River.

Glacial Features of Lower Michigan: Frank Leverett, Ann Arbor, Mich.

The paper was illustrated by maps and diagrams setting forth the relation of the Michigan, Saginaw and Huron-Erie ice-lobes in lower Michigan during the Wisconsin stage of glaciation, and represents three years of field work for the United States Geological Survey. Especial attention was given to eskers, and their bearing upon the question of superglacial or subglacial origin is discussed. An extensive drumlin area was briefly described in its relation to ice movements and moraines. The paper closed with reciting the evidences of earlier ice invasions than the Wisconsin which have been found within the limits of the Wisconsin drift.

Studies in the Glaciation of the Berkshire Hills, Massachusetts: Frank B. Taylor, Fort Wayne, Ind.

The Berkshire Hills lie within the area covered by the retreating Hudson Valley lobe of the Labrador ice-sheet. The retreat of the ice-front across Berkshire County was from southeast to northwest and the trend of the front was northeast and southwest, the apex of the lobe resting on the central axis of the Hudson Valley. In the lower, less mountainous region near the Hudson River, the moraines and border drainage features, though faint, are continuous, so that the positions of the ice-front at its several halts are traceable continuously. In Berkshire County continuous tracing is not possible, the borders there being marked by fragmentary terminal and lateral moraines, mostly very slender, and by remains of border drainage. The extremely serrate character of the ice margin at each halt, coupled with the frequency of the halts, makes interpretation difficult. The average interval between successive recessional moraines is about three and one half miles. The paper was devoted mainly to a discussion of the method of interpretation, showing, first, that, by the circumstances of the recession across this county, the moraine marking each halt of the ice-front may be safely regarded as an individual, separate and distinct from the moraines of earlier and later halts; and, second, that interpretation on this assumption unifies and explains the morainic phenomena of Berkshire County satisfactorily.

The Geological Age of the West Indian Volcanic Foundation: J. W. Spencer, Toronto.

From personal explorations the author has found that the whole Caribbean plateau is underlain by an igneous basement of pre-Tertiary age. This foundation occurs not merely beneath the older Tertiary limestone, but also on those islands where such have not accumulated, or have been removed by denudation, and are now surmounted by volcanic ridges. The igneous formations have been analyzed, and their relationship to the later fossiliferous deposits show that the volcanic activity was renewed about the close of the Pliocene period, and has continued intermittently since that time. And it also seems probable that there was a long quiescence during the greater part of the Tertiary period.

The Geologic and Physiographic History of the Lesser Antilles: Robert T. Hill, U. S. Geological Survey.

The author stated that the Windward chain of islands from the Anegada Passage to the South American coast consisted of three distinct types of islands: (1) Those of the Virgin chain, which were Antillean in their relationships; (2) those of the Caribbee chain, which were constructional volcanic forms; and (3) islands of the Trinidad type, which were detached portions of the South American continent. Besides these types there is the semblance of an outer circle of islands, including Antigua, Grande Terre (Guadeloupe) and Maria Galante, consisting of marine sedimentaries veneered upon old volcanic piles. Barbados is in a class by itself, with probably South American relations. Vulcanism has prevailed in the Caribbean islands since Cretaceous time, and the volcanic ejecta have consisted essentially of horneblende-andesites throughout. Physiographically the islands are of several distinct types. The Caribbee Islands proper are strictly constructional forms modified somewhat by rainfall erosion, and truncated around the edges by marine erosion. The changes of level have been more or less epeirogenic, but never, at least since Jurassic times, has there been any connec-

tion between the Windward Islands and the mainlands. There is absolutely no topographic or geologic proof that the volcanic Caribbees are of other than progressive constructional origin, or that any continent or semblance of a continent ever prevailed on their present site.

Mont Pelée—the Eruptions of August 24 and 30, 1902: Angelo Heilprin, Philadelphia, Pa.

The paper described the author's experiences during the great eruptions of these dates, being actually high upon the eastern slope of the volcano during the outburst of August 30, when Morne Rouge was destroyed. Morne Rouge was destroyed by a volcanic blast from the crater similar to that which devastated St. Pierre early in May. Lantern slides from the author's negatives showed the inner cone overtopping the rim of the ancient great crater.

The Principal Causes of Death during the Eruptions of Mont Pelée and La Soufrière: Israel C. Russell, University of Michigan.

A review was presented of the evidences bearing on the question mentioned in the title, and arguments brought forward to show that the chief agent of death was highly heated, dust-laden steam.

Secondary Volcanic Phenomena of the West Indian Eruptions of 1902: George Carroll Curtis, Boston, Mass.

Fresh evidences of geologic work, which could not be credited to the main phenomena of eruption alone, were found by those early upon the field after the West Indian eruptions in 1902. Over the area lay a large amount of volcanic ejecta upon which erosion forces were rapidly working. An excellent opportunity was thus afforded for the study of stream development upon an initial cover. Portions of the coastal plain had subsided; other deposits had undergone elevation; tidal waves had swept the marginal slopes; and marine erosion was rapidly altering new deposits. Flows of mud-like detritus had filled valleys, extended their deltas seaward, entombing villages and inhabitants. From the valley floors minor eruptions were taking place, giving rise to early reports that lateral craters connected with the main source of volcanic energy had played important parts in the great eruptions. Detailed study of these eruptions on the actual ground indicates that they were not from a primary volcanic source, but that they formed a series of secondary manifestations with origin, process of outburst and topography developed peculiar to themselves.

Some Erosion Phenomena on Mont Pelée and Soufrière: Edmund Otis Hovey, American Museum of Natural History.

The stripping of the volcanoes Pelée and Soufrière of all vegetation by the eruptions, and the deposit of fresh fragmental material over the whole, gave excellent and unusual opportunity for observation of the development of new erosion forms (particularly dendritic drainage) on old surfaces.

The Inner Cone of the Mont Pelée Crater and its Relation to the Destruction of Morne Rouge: Edmund Otis Hovey, American Museum of Natural History.

The growth of the inner cone of eruption above the western opening beside Étang Sec caused the partial closing of the great gash in the side of Mont Pelée, and finally lifted the main vent above the rim of the great crater, to a point where there ceased to be any hindrance to the radial expansion of the explosions.

Origin of the Sandhill Topography of the Carolinas: Collier Cobb, University of North Carolina.

Many of the sandhills show the structural features of æolian cross-bedding seen on Hatteras. Unlike most dune sands,

those of the Carolina coast contain many fragments of potash feldspar, being essentially the same in composition as the beach sands, which may account for the presence of the potash in the coastal plain soils, while explaining the origin of some of the topographic features.

Recent Changes in the North Carolina Coast, with Special Reference to Hatteras Island: COLLIER COBB, University of North Carolina.

Hatteras Island is being added to on the sound side and taken from on the ocean side north of the cape, and a new inlet is being made between the cape and Kinnakeet. South of Cape Hatteras the island is growing on both sides, but is extending in a southeasterly direction. The rate of change has been noted by the planting of cedar posts, and noting the changes of shore line with relation to posts, trees and various natural objects through the years 1892–1902.

The Hanging Valleys of Georgetown, Col.: W. O. CROSBY, Massachusetts Institute of Technology.

The paper describes chiefly the break of several hundred feet between the floor of the valley of Clear Creek and that of Leavenworth Creek, one of its principal tributaries, and explains it as due, not to fluvial or glacial erosion, but to faulting, of which abundant independent evidence is afforded by mining developments. Other and similar features in the vicinity were correlated with this, and it was shown that the part of the main valley occupied by Georgetown is a depressed fault-block or graben, and that the valley is, therefore, due in part to displacement and not wholly to erosion, suggesting comparison with Yosemite Valley. The idea was also advanced that the elevation of this oldest of the Colorado ranges has been recently, and may be still, in progress, and that while in the past the movement has been chiefly massive, developing the great fault-scarp overlooking the plains, it has in later times affected the axis more than the axis of the orographic block, leading to a marked tilting of the Cretaceous peneplain; and in part, at least, it is very locally differential, and in the Georgetown instance in a degree to accelerate the topography.

Further Notes on Lake Arickaree: J. E. TODD, Vermilion, S. D.

Lake Arickaree was a glacial lake formed in the valley of Moreau and Grand Rivers, South Dakota, with its axis corresponding with the Missouri River in that region. The region was first visited by the author in 1890, and a description of its peculiar southern margin preserved as a bowldery ridge above the north side of Fox Ridge, reported in 'Bulletin 144' United States Geological Survey. He visited the region again this past summer, discovered another outlet, and traced the margin more definitely.

The Problem of the Loess in the Missouri Valley Compared with that in Europe and Asia: G. FREDERICK WRIGHT, Oberlin College.

The physical resemblances between the loess deposited in the Missouri Valley and that in southern Russia and in Turkestan and northern China are perfect; but in general distribution there is great diversity. In China the deposits occur in vast wind-blown masses near the summits of the mountain-border on the east coast of Mongolia, up to five thousand feet above the sea. Elsewhere, however, only in the lower areas are they distributed over level areas, evidently by water action; while at the head of the plain extending west from Peking, near the Nankau Pass, there are evident deltas six hundred feet above the sea, consisting of loess mingled with large transported blocks of rock. Along the

northern base of the Ala Tan Mountains in Turkestan, and along the western base of the Thian Shan Mountains, the delta-like characteristics of the distribution are evident, maintaining a pretty general level of twenty-five hundred feet above the sea. Over the southern plains of Russia the deposit maintains a pretty general level of six hundred feet, having a scope of from fifty to a hundred feet over everything, though the rivers have cut channels three hundred feet deep in the more southern portions.

In the Missouri Valley there is also a definite relation to the streams. On both sides of the Missouri the deposit is developed from Yankton to Kansas City in almost equal degree, having a depth of a hundred feet or more. Both in the Missouri Valley and in the lower levels in China there are also frequent indications of water action in more or less obscure lines of bedding, while in both areas fossils are scarce, and are mostly of land species which love moist places. In China the source of material is certainly not from a glaciated area, while in the Missouri Valley it is probably both from the adjacent glaciated area and from the arid plains to the west. In both areas the distribution by water is best accounted for on the theory of an extensive subsidence of land over the entire northern hemisphere. In the Missouri Valley the following order of earth movements seems best to fit the facts:

1. Pre-Glacial elevation of two thousand or three thousand feet. This continued until the close of the Kansas stage.

2. Depression increasing toward the north until the level was considerably below present level. This closed the Iowan stage, and was accomplished by the main loess deposits, while the gradient of the river was reduced to a few inches per mile and the water action increased from ten to twenty feet during the late summer melting of the ice, covering all the adjoining land for a few weeks, and then leaving it bare for the rest of the year. Thus the peculiar fossils may be accounted for.

3. An elevation increasing to the north with an east and west axis near the latitude of Omaha, culminating in the Wisconsin stage. The once waste grounds from the Wisconsin moraines down the Big Sioux River are a mile and a half wide and only ten feet above the present flood plain. These continue for a little distance down the Missouri after reaching Omaha. Below Omaha there has been filling, instead of erosion, since the Wisconsin stage. This would give to the loess deposits of undoubted Iowan age.

A New Meteorite ('Bath Furnace') from Kentucky: A. M. Miller, Lexington, Ky.

The meteorite exhibited was the one which occasioned the brilliant display seen at 6.45 P.M. of November 15 by many persons in the states of Ohio, Kentucky, Tennessee, Louisiana, Mississippi, Alabama and Georgia. Its detonations, associated with the checking of its orbital velocity by the resistance of the air, startled the inhabitants of Bath County, Kentucky. It actually struck the earth in the road in front of the house of Mr. Bluford Staten. The latter, an eye-witness of the event, picked the stone up on the following morning. It passed next into the hands of Mr. W. H. Daugherty, of Owingsville, Ky., from whom it has been purchased by Professor Henry A. Ward for the Ward-Coonley collection, New York City. The meteorite is an aerolite containing, among other substances, disseminated nickeliferous iron, and it exhibits the usual black crust with pittings. Before chips were removed for analysis the specimen weighed nearly thirteen pounds. Specific gravity, 3.48.

Science at the World's Fair, St. Louis, 1904: J. A. HOLMES, St. Louis, Mo.

The exhibits at the approaching Universal Exposition to be held in St. Louis, from April 30 to December 1, 1904, will endeavor to show the applications of science in all the great industries of the country; and in some of these departments, notably that of mines and metallurgy, it is proposed to show the equipment and methods of geological surveys and similar institutions for geologic, geographic and metallurgic research; in fisheries will be shown methods and equipment for biologic research; in liberal arts, laboratory research equipment in many branches of science; in education, equipment and methods of instruction and research at the institutions of learning; in the department of electricity will be shown modern equipment and methods of electrical research. In addition to the above, arrangements are being made for holding, under the auspices of the exposition, a number of scientific congresses for the discussion of methods and equipment, and general plans for research, in all departments of knowledge.

EDMUND OTIS HOVEY,
Secretary.

OPENING EXERCISES OF THE WASHINGTON POST-GRADUATE MEDICAL SCHOOL.

THE opening exercises of the Washington Post-Graduate Medical School were held in the presence of a distinguished audience on Monday evening, January 12, 1903, at 8 o'clock in the lecture hall of the Columbian University.

Addresses were delivered by Professor Wm. H. Welch, M.D., of Johns Hopkins University, and by the president of Columbian University on behalf of the educational institutions. The rector of Georgetown University was unable to be present, but sent words of welcome and encouragement to the new school.

Professor Welch emphasized especially the many advantages of the National capital as an educational center, and spoke in the most appreciative terms of the work performed in the government laboratories, by men who are also connected with the teaching staff of the graduate school. The speaker expressed great gratification that the department of preventive medicine had been given deserved prominence, and in this respect characterized the attempt as unique, in this country at least, and one which could not fail to be appreciated by all interested in scientific medicine. He referred to the advantages which must accrue to the students by the utilization of the hygienic laboratory of the public health service, the laboratories of the Army and Navy Medical School, the biochemic laboratories of the Department of Agriculture and the demonstrations which are possible in the Army Medical Museum and the Museum of Hygiene. He stated that the advantages for securing a thorough training in preventive medicine and in the study of tropical diseases are unexcelled anywhere, and predicted a useful future for the school, in the training of men who desire to become health officers, medical officers of the army, navy, marine hospital or the colonial service.

Dr. Needham welcomed the school among the educational institutions, and expressed satisfaction that the leading medical schools of the city had united in placing their laboratory and teaching facilities at the disposal of the graduate school, thus insuring a hearty cooperation in the promotion of higher medical education.

General Sternberg, the president of the faculty, in behalf of the school, returned thanks to the medical departments of Columbian and Georgetown universities and all hospitals in the city, government, private and municipal, for their

generous offer in placing their facilities at the disposal of the graduate school; he emphasized the clinical advantages, which are unusually great in proportion to the population, on account of the several large government institutions aggregating over 4,000 beds, with an excellent corps of teachers. The president then delivered his introductory lecture on 'Preventive Medicine,' tracing the progress and achievements of hygiene and the methods by which the beneficial results have been accomplished. The teaching staff of the school consists of 85 professors and adjunct professors. Clinics every day from 9 A.M to 2 P.M. Laboratory work every week day from 2 to 5 at the School of Medicine, Georgetown University, 920 H Street.

The following constitute the board of directors of the Graduate Medical School: General George M. Sternberg, U.S.A., President (address, 2144 California Ave.); J. Ford Thompson, Vice-President; George M. Kober, Secretary and Treasurer; Walter Wyman, Surgeon-General, Public Health and Marine Hospital Service; P. M. Rixey, Surgeon General U. S. Navy; R. M. O'Reilly, Surgeon General U. S. Army; A. B. Richardson, Superintendent Government Hospital for Insane; Samuel S. Adams, M.D., Swan M. Burnett, M.D., Joseph Taber Johnson, M.D., Sterling Ruffin, M.D., Edward A. Balloch, M.D., E. A. de Schweinitz, M.D., H. L. E. Johnson, M.D., William C. Woodward, M.D.

From the foregoing it would appear that here we have the foundation for the establishment of a school of preventive medicine, a most worthy undertaking, and the important question arises how many of our young medical men will avail themselves of this opportunity, especially when the average graduate may reason that he has devoted his time, money and energy to equip himself for the recognition and cure of diseases, and who will pay him for their prevention? It is evident that so long as no special qualifications are demanded for the appointment of health officers in the United States, a voluntary training in preventive medicine will be sought by a comparatively limited number, and yet the undertaking is of such far-reaching importance to the general public, that the establishment of fellowships in this school appears urgently called for. We know of no branch of science which has contributed so much during the past twenty-five years to the sum total of human happiness than sanitary science, and perhaps no field affords better prospects for fruitful results than the endowment of a school of preventive medicine.

SCIENTIFIC BOOKS.

Postelsia: The Year Book of the Minnesota Seaside Station, 1901. St. Paul, Minnesota. 1902. Small 8vo. Pp. 229.

This unique book is one outgrowth of the work done at the Vancouver Seaside Station of the University of Minnesota in the summer of 1901. It consists of seven papers which were given before the members of the station, covering the following subjects: 'Uses of Marine Algæ in Japan,' 'The Distribution of Plants in Colorado,' 'The Phylogeny of the Cotyledon,' 'Botanizing in Jamaica,' Algæ Collecting in the Hawaiian Islands,' 'The Distribution of Marine Algæ in Japan,' and 'The Kelps of Juan de Fuca.' These are illustrated by twenty-nine plates, three of which are reproductions of Japanese pictures showing the methods of collecting and preparing certain seaweeds for food.

It is difficult to decide which are the more interesting of these papers. One becomes greatly interested in the account given by Mr. Yendo of the uses to which marine algæ are put in Japan, and can not close the book until he has finished the paper. Then should he happen to open the book where Miss Butler describes her experience in Jamaica, he is charmed with the style of the enthusiastic

writer, who is an acute botanist as well; but just as he concludes these interesting pages he comes upon Miss Tilden's paper on botanizing in the Hawaiian Islands, and is fascinated again. So it is with all the articles. There is not a dull paper in the seven, and the editor is to be congratulated upon his skilful selection. He has achieved something literary in this volume, while at the same time adding not a little to our botanical knowledge. It is one of the very few botanical books which possess a distinctly literary flavor, and for this reason, in addition to its botanical merits, it is to be highly commended.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 364th meeting was held Saturday, January 10.

Walter H. Evans stated that a bill had just been passed making a forest reserve of that portion of Porto Rico containing the only tract of primitive forest now remaining on the island.

Mr. L. O. Howard exhibited a series of lantern slides giving a pictorial history of the recent investigation of the etiology of yellow fever by the Army Yellow Fever Commission and the subsequent Board of Health of Havana. The slides included photographs of Major Reed, Drs. Carroll, Lazier and Agramonte, Dr. Carlos Finley, and Dr. Guiteras, as well as of Camp Lazier, the Las Animas Hospital and laboratories, and a number of others. He spoke eulogistically of the work of the commission and dwelt on the enormous value to humanity of the results of their work. He referred to the deaths of Drs. Reed and Lazier, and mentioned the memorial raised to the latter, and that now in progress for the former, as deserving in the highest degree of contributions from all scientific men. He also stated that in honoring the immortal dead we must not forget the living, and reminded the society that Dr. James Carroll, one of the society's members, was a member of the commission and in the thick of the struggle had been attacked with yellow fever but fortunately had recovered, and that he should receive the highest honor for the rest of his life.

S. F. Meek spoke on 'The Geographic Distribution of the Fresh-water Fishes of Mexico,' illustrating his remarks with lantern slides. He stated that four distinct fish faunas were represented in Mexico—that of the Rio Grande, with 80 species; the Colorado, with 9 species in western Sonora; the Lerna basin, with 49 species; and a tropical fauna with 137 species. The fauna of the Lerna basin was the most remarkable, for of the 49 species not one was found in any other river, while 9 of the 18 genera were peculiar to this basin. Sixteen of the species belong to the salt-water family Atherinidæ, and were the only salt-water fishes represented on the Mexican plateau. Seventeen species, including one *Gambusia*, belong to the Pœcilidæ, and all are viviparous. With the exception of the *Gambusia* these have the first six rays of the anal fin short and stiff, and having the same position in the males and females, while the viviparous Pœcilidæ previously known have the anal fin slender and placed well forward. The speaker noted that the tropical fishes extended northwards in a belt on the east and west coasts, reaching the highest latitude on the east. On the west coast the Cichlids extend to Mazatlan, and the Characins reach only to the Balsas, while on the east coast the Characins are the most northerly. He was of the opinion that the fish fauna of the Rio Grande region was derived from the Mississippi Valley, and that of Sonora from the Colorado. As for the Lerna region he believed that it was an island with a well-established fauna before a rise of the continent made it part of the mainland, and that it has since been a center of distribution.

O. P. Jenkins discussed 'The Rate of the Nervous Impulses in Certain Invertebrates,' saying that so recently as fifty years ago the most diverse opinions prevailed regarding the speed of nervous impulses, and that it had even been thought to exceed the speed of light. The experiments of Helmholtz showed that the rate was comparatively slow, being in the frog but ninety feet a second. Mr. Jenkins then detailed his own experiments

with various invertebrates, saying that he had found the lowest rate, 44 cm. per second, in a species of *Limax*, and the highest, 424 cm. per second in a squid; this rate was subject to very considerable individual variation.

Incidentally he noted that the collection of marine invertebrates showed a large number of new species of marine worms, and that the coast of California would probably prove a good collecting ground. F. A. Lucas.

MEETING OF THE SAN FRANCISCO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

A regular meeting of the San Francisco Section of the American Mathematical Society was held at the University of California on December 20, 1902. Sixteen members of the society were present. By an amendment of the by-laws the name of section was changed from Pacific to San Francisco. The following papers were read:

Professor R. E. Allardice: 'On a system of similar conics through three points and its transformation group.'

Professor H. F. Blichfeldt: 'On a property of conic sections.'

Professor L. E. Dickson: 'Generational relations for the abstract group G simply isomorphic with the linear fractional group in the Galois field of order p^n.'

Professor L. M. Hoskins: 'A simple method of determining the free nutation of a yielding spheroid.'

Dr. D. N. Lehmer: 'On the parametric representation of the tetrahedroid surface.'

Professor A. O. Leuschner: 'Elimination of aberration and parallax in calculating preliminary orbits.'

Mr. W. A. Manning: 'The positive primitive substitution groups of class $2p$, p being any prime.'

Professor G. A. Miller: 'On the holomorph of a cyclic group.'

Dr. C. A. Noble: 'A problem in relative minima.'

Dr. S. D. Townley: 'The probability of collisions amongst the stars.'

Professor E. J. Wilczynski: 'On a certain congruence associated with a given ruled surface.'

The paper by Professor Dickson was presented by the secretary. In the absence of Professor Leuschner his paper was read by title. The other papers were presented by their authors. The next meeting of the section will be held at Stanford University in May, 1903. G. A. Miller, *Secretary*.

CORNELL SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The Cornell Section of the American Chemical Society was organized in December last, and has now received its charter from the national organization. The territory embraced by the section is that lying within a radius of ten miles from Cornell University, Ithaca, N. Y., with headquarters at the university. At the time of organization there were twenty-four members of the American Chemical Society who became charter members of the Cornell section. Since then the membership has increased to forty-four.

The officers for the current year are:

President—Professor L. M. Dennis.

Vice-President—Professor W. D. Bancroft.

Secretary-Treasurer—Mr. W. C. Geer.

Executive Committee—Messrs. Dennis, Bancroft and Geer, *ex officio*, Professor W. R. Orndorff, Mr. J. E. Teeple and Mr. J. G. O'Neill.

Councilor from Cornell Section—L. M. Dennis.

Councilor ex officio—G. C. Caldwell.

The meetings of the section are to be held monthly in Morse Hall, Cornell University. The evenings will be occupied largely with original papers read by members of the society, but it is planned to vary the meetings with occasional lectures or addresses by men well known for work in special fields. Thus in the course of the year there will be interspersed with the original papers, addresses on subjects of technical importance and on the more chemical phases of allied sciences. By this means the society will conserve all the fundamental aims of the American Chemical Society, as well as aid in broadening the horizon of the members of the section by keeping them in touch with the progress of those sciences which so frequently extend into the fields of chemical research.

The first meeting was held on the evening of December 15. Papers which presented the results of original work done in the chemical department were read and discussed. Mr. E. S. Shepherd read a paper on the

'Alloys of Lead, Tin and Bismuth'; Mr. G. H. Burrows, on 'Reduction with Soluble Anodes'; and Mr. J. G. O'Neill on 'The Determination of the Benzene in Illuminating Gas.'

At the second meeting, which was held on the evening of January 12, the section was addressed by Professor W. D. Bancroft, on the 'Theory of Indicators.' The lecturer illustrated his remarks by many experiments which were explained on the basis of the theory of electrolytic dissociation.

The favorable auspices under which the Cornell Section begins existence seems to augur for it a highly successful future.

W. C. GEER,
Secretary.

ELISHA MITCHELL SCIENTIFIC SOCIETY.

THE 144th meeting was held in Person Hall, University of North Carolina, Tuesday, December 9, at 7:30 P.M.

The secretary called attention to the importance of the coming Washington meeting of the American Association.

Professor J. W. Gore spoke of his experiments on 'Wireless Transmission of Electrical Energy.'

Mr. Gore called attention to the fact that an ordinary telegraphic current will cause a coherer to respond when the antenna is near and placed in any position relative to the current. When at right angles, this effect cannot be due to the cutting of the antenna by magnetic lines of force from the current. It is to be inferred that electrostatic induction causes the action of the coherer, just as is the case when the antenna is near an open circuit connected to a terminal of an induction coil, or near an insulated conductor whose potential is suddenly changed.

It was stated that possibly wireless transmission of energy is due to the propagation of waves started by oscillatory electrostatic stresses between earth (conductor) affected ether and the ether some distance above the earth.

Mr. R. O. E. Davis, in a paper on 'Improvement in Method of Halogen Determination,' presented the results by Professor Baskerville and himself in their efforts to obtain a more satisfactory method for the determination of chlorine in their work on the atomic weight of thorium. Abstract of his paper has been printed in the *Proceedings* of the North Carolina Section of the American Chemical Society.

Mr. G. N. Coffey, of the United States Soil Survey, gave an interesting account of its work in the field and laboratory, and the benefits to be derived therefrom.

CHAS. BASKERVILLE,
Secretary.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

January 9.—Dr. A. A. Julien reviewed 'Recherches Geologiques et Petrographiques sur L'oural du nord,' par Louis Duparg. Among the new rocks noted was koswite, which is composed of olovine and pyroxene cemented together by magnetite. Dunite also occurs there in great continuous sheets, with its individual grains much larger than that from North Carolina.

January 16.—Professor Kemp gave a talk upon some large specimens of covellite which he had just received from Butte, Mont.; also upon some native gold in a quartz vein from the North Star Gold Mines, Grass Valley, Cal. This latter was obtained at a vertical depth of about 2,000 feet. He also showed and commented favorably upon Professor J. C. Branner's 'Syllabus of a Course of Lectures on Elementary Geology.' Mr. G. I. Finlay discussed the method of recalculation of chemical analyses as applied to the new system of classification of igneous rocks.

January 23.—Professor Kemp showed some platinum nuggets from British Columbia, some large specimens of ruby silver ore from Chili, and rich copper ore from Summerville, N. J. Mr. G. I. Finlay then continued from the previous week his discussion of the new classification of igneous rocks. Professor Kemp will take up the discussion next week.

H. W. SHIMER.

DISCUSSION AND CORRESPONDENCE.

THE USE OF THE WORD GEEST IN GEOLOGY.

To the Editor of Science: The *American Geologist* for December, 1902, reprints an extract from the 11th Annual Report U. S. Geological Survey, by W J McGee, upon the use of the term *geest* in geology. Dr. McGee calls attention to the fact that there is no general term in common use to designate the undisturbed products of weathering, and proposes the Dutch word *geest,* as used by De Luc, Eaton and Beck, to distinguish such material *in situ* from *alluvium* or transported material. Dr. McGee overlooks the fact that *geest* and *alluvium* are themselves specific terms denoting members of a class, while for the class itself a common descriptive or 'denotative' term is still wanting. In his first sentence he introduces his subject as 'the superficial mantle of rock débris.' Later it appears as 'the extensive mantle,' etc., and 'the unconsolidated materials by which these [solid] rocks are mantled.' Every recent writer upon geology and physical geography has had to wrestle with this problem and has usually solved it by some circumlocution. The older writers, Lyell, Dana, Prestwich, Geikie, Le Conte and even Scott use only the term *soil,* and appear to do so without any sense of unfitness or inadequacy. Brigham ('Text-book of Geology') discusses 'the whole sheet of crumbled rock material which mantles most of the rocky foundation of the lands,' but finds no better term for it than 'this mantle.' Elsewhere he uses 'rocky débris' and 'land waste.' Gilbert and Brigham ('Introduction to Physical Geography') use several variations of the theme, 'earthy mantle that covers the rock,' 'waste cover,' 'earthy cover,' 'waste mantle.' They state explicitly: 'The student should distinguish clearly and use it [soil] only of the veneer of earthy matter which is especially fitted to support life.' Davis ('Physical Geography') commonly uses *waste* with various modifiers, as 'rock waste,' 'land waste,' 'sheet of loosened rock waste,' 'cloak of rock waste,' 'waste sheet.' In the *Journal of Geology,* Vol. 10, p. 98 ff., he uses many times the phrases 'sheet of waste' and 'cloak of waste.' Merrill ('Rocks, Rock Weathering and Soils') strikes out boldly and manufactures a new term, *regolith,* blanket rock for the 'entire mantle of unconsolidated material, whatever its nature or origin.' For non-classical students I have translated regolith into *mantle rock,* and have used that term for several years with perfect satisfaction. The above quotations show how difficult it is to avoid some term expressive of the idea of a cover or mantle. *Waste* is open to the objection that it expresses a half truth in such a way as to give a false impression. It is waste only in relation to its past. In its destination and future functions it is not waste, but 'the dust of continents to be.' It is always a mantle which covers some other kind of rock, and in geography the distinction between the mantle and that which it covers is more important than the distinctions between aqueous, igneous and metamorphic rocks. I suggest, then, the term *mantle rock* for the material which Merrill has named the regolith, and hope that it may find favor and supply a long-felt want. It is plain Saxon, expresses the most distinctive and striking character of the material, has no misleading implications and fits readily into any place where it is needed. I find in the note-books of my students such records as these: "Lawrence Co., bed-rock limestone, mantle red clay. Green Co., bed-rock shale, mantle glacial drift." To substitute waste, detritus, débris, geest, alluvium, unconsolidated materials, or any other term for *mantle* in these phrases would be distinctly no improvement.

Charles R. Dryer.

Terre Haute, Ind.

ATAVIC MUTATION.

To the Editor of Science: Dr. White's article on aggregative atavic mutation of the tomato, in Science for January 9 recalls to me a case of—apparently—similar atavic mutation, which Dr. White should be in a position to investigate, if, indeed, he has not already done so. When I lived in Washington, some ten years ago, we were rarely able to get any really *sweet* sweet corn, such as is so abundant here in New England. The

vegetable commonly found in the market was as tasteless as white field corn. The market people told us that to obtain sweet corn, it was necessary to plant northern seed every time, while the seed corn grown from northern seed always gave the tasteless variety.

Since, I believe, our sweet varieties of corn are derived by cultivation from the white field corn, this looks very like a case of atavic mutation. I hope that Dr. White or some other investigators in Washington may be able to give us further information about this matter.

JOHN MURDOCH.

PUBLIC LIBRARY, BOSTON, MASS.,
January 12, 1903.

NOTES ON INORGANIC CHEMISTRY.

DISCOVERY OF NEW PLATINUM DEPOSITS.

A NEW YORK *World* dispatch from St. Petersburg of the date January 18 announces the discovery of vast deposits of platinum on the river Gusseva. It is said that within a month 25,000 men swarmed to the diggings, and before the police could reach the camp the miners got away with $1,500,000 worth of platinum. The locality indicated in the dispatch is in the upper, or Goroblagodatsk district, on the eastern watershed of the Oural Mountains. The mines of this region are chiefly owned by Count Shouvalof and a number of companies. About eighty miles to the south is the Nizhni Tagilsk district, which is owned by the Demidoffs, and which has been the greatest producer of platinum in the past. The last few years the northern district has been a larger producer, but the sands and rock have run very low in platinum. While as recently as 1870 the richness of the sands was as high as one ounce to the ton, in 1895 the average was hardly one and a half pennyweights to the ton. The total production of that year was less than 150,000 ounces. If the figures of the *World* dispatch are reliable, it would indicate the production in a month of more than the usual annual output of late years. The platinum problem has become a very serious one, for while the demand has increased rapidly the last few years, the supply has been diminishing. Great efforts have been made to discover new fields, but without much practical success. Platinum occurs in many places, but generally in insufficient quantities to pay for working. The Goroblagodatsk district consists chiefly of the river Iss and its tributaries. The total length of these streams is about sixty miles, and the Gusseva is one of these affluents. Allowing for all the probable exaggeration of the dispatch, it would seem that deposits have been discovered in this region which must be far richer than any which have been worked for many years. It is sincerely to be hoped that they shall prove to be of considerable area.

J. L. H.

CURRENT NOTES ON METEOROLOGY.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

THE 'Report of the Chief of the Weather Bureau' for 1901–1902 (4to, pp. 342) contains a number of interesting facts regarding the work of the Bureau. The storm warnings issued for the transatlantic steamship routes were so successful that the secretary of 'Lloyd's,' in London, conveyed to the Chief of the Bureau the congratulations of his committee 'on the infallibility of the predictions that have been supplied by the forecasts.' On August 1, 1902, 10,025 rural free mail-delivery routes were in operation, serving approximately 1,000,000 families. Of these families, 105,000, served by about 1,000 routes, were furnished with the forecasts of the Weather Bureau. If the necessary funds were available, it would be possible to make the distribution of the daily forecasts coextensive with the rural free delivery itself. Professor Abbe has acted as the general adviser of the trustees of the Carnegie Institution on matters pertaining to meteorology, and has also been charged with the oversight of the aerial research work of the Weather Bureau. A valuable set of nephoscope observations from the West Indies has been secured, from May, 1899, to May, 1902. Among the special studies carried on by the Bureau are the following: Investigation of the intensity of solar radiation by means of Angström's electric compensation pyrheliometer; a new barometric

system for the United States, Canada and the West Indies; a discussion of the vapor tension observations throughout the United States; a study of wind velocities and fluctuations of water level on Lake Erie, and of eclipse meteorology and allied problems.

The 'Report' also contains, besides the usual tables, tables showing the highest and lowest temperatures recorded at Weather Bureau stations for each month of the year, from the beginning of observations until the end of 1901 (with charts); the monthly and annual mean relative humidity for all Weather Bureau stations (with charts), etc.

SIMILAR BAROMETRIC VARIATIONS OVER LARGE AREAS.

Sir Norman Lockyer and Dr. W. J. S. Lockyer, in England, and Professor F. H. Bigelow, in this country, have lately been investigating the similarity of curves representing many solar and meteorological phenomena. Several papers on this subject have already been published. In *Nature* for January 8, Dr. Lockyer presents some of his latest results. The curves showing the variations in pressure at Bombay, Colombo, Batavia, Mauritius, and Perth Adelaide and Sydney, Australia, are strikingly similar and indicate that the same kind of variations are in action over the whole region. The curves for Cordoba, Mobile, Jacksonville, Pensacola and San Diego, and the *inverted* curve for Bombay are also very similar to one another. Here, then, are two large areas indicating similar barometric variations from year to year, but one showing an excess while the other displays a deficiency. Professor Bigelow has also come to the conclusion (*Monthly Weather Review,* XXX., 347) that the same pressure variations prevail over very large areas, but that they vary from one district to another. Dr. Lockyer points out that the two investigations agree as to the following points: (1) The close connection between solar activity and barometric pressure; (2) the great extent over which very similar pressure variations exist, and (3) the presence of two large areas, the pressure variations over which are the reciprocal of each other.

WINTER ARIDITY INDOORS.

The dryness of the air in furnace-heated houses is attracting more and more attention. In Science for March 23, 1900 (N. S., Vol. XI., 474), reference was made in these Notes to some observations of relative humidity made by the undersigned in his study during three weeks of November, 1899. In the *Journal of Geography* for December last, Professor Mark S. W. Jefferson, under the title 'Winter Aridity Indoors,' presents a simple mathematical treatment to show the actual quantities of water demanded in connection with a heating and ventilating plant to preserve a healthful humidity within doors in winter. Professor Jefferson concludes that, under the average conditions of temperature and humidity indoors during the three weeks referred to above, about two gallons of water per individual should be evaporated to humidify the daily supply of air. Such observations as these naturally suggest a useful line of work in connection with giving the air from our furnaces a proper supply of moisture.

NOTES.

The rapid advance of balloon and of kite meteorology is evidenced by the fact that a new meteorological station has been established at Viborg, in northern Jutland, for the express purpose of carrying on the investigation of the free air by means of kites and balloons. This station is maintained through the cooperation of French, Swedish and Danish meteorologists. The location is an admirable one, being in a district where storms are frequent. Twenty-eight persons constitute the force at the new observatory, in whose establishment Messrs. de Bort, Hildebrandsson and Paulsen have been chiefly concerned.

R. DeC. Ward.

ELECTRICALLY UTILIZED POWER AT NIAGARA FALLS.

Recent Consular Reports include one from Consul H. W. Brush, at Niagara Falls, Ontario, Canada, on the development of hydraulic power from the great falls. The original development of 50,000 horse-power on

the American side is now to be supplemented by an equal amount, the constructions for which are well under way. It is expected that about 50,000 horse-power will become available on the Canadian side toward the end of the coming summer, and contracts already signed contemplate a total of not less than 110,000 horse-power in units of 10,000 horse-power each, double the first unit, then considered a tremendous experiment. A new company, the Ontario Power Company, on the Canadian side, contemplates a plant to deliver 50,000 horse-power at the start and 150,000 ultimately. This, like the original corporations on both sides the gorge, is largely backed by capital from the United States. A new company will probably be presently authorized by the Canadian government, which will presumably, at the start at least, be wholly Canadian. This will mean the further development of 100,000 horse-power. About 350,000 horse-power may thus be expected to be soon supplied, and it is computed that it will result in the influx of about $7,000,000 annually as rental. Within ten years, it is prophesied that a million of horse-power at least will be developed at Niagara Falls.

Efforts have been made to observe the effect of the present maximum draught of water from the falls; but the most careful measurements and observations are reported to have failed in indicating, much less measuring, any effect when the power is turned on and off. The effect of a wind blowing up or down channel is, on the other hand, very observable, and a heavy blow may alter the level of the water at the entrance to the Niagara River and at the head of the rapids by several feet; but its effect at the falls is too slight to be readily observed, except by those who are familiar with the river in all its aspects.

The horse-power of Niagara is a somewhat uncertain quantity, and is variable with every wind and with every change of season. The first survey, made with the object of measurement of the power available at the falls, was, if the writer is not misinformed, that of Mr. L. M. Wright, a quarter of a century ago, or more, who employed the famous ferryboat, *Maid of the Mist*, driving her stem up under the cataract as closely as the swift current would allow, and securing measurements of rate of flow at that and other cross-sections of the river. He allowed the writer to make extracts from his notes at the time.

He found the section thirty yards below Chippewa Creek to measure 6,667 feet across, with a depth of 15 feet. He estimated the minimum power of the total fall as 11,363,636 horse-power, and the maximum as a third greater; the variation being due to the action of the winds on the Great Lakes. These figures are probably too great. A number of estimates have been since published, usually much less. The Lake Survey gave, for example, as reported, about 280,000 cubic feet, per second, as the flow at the falls; while the pioneer observer gave 500,000. Taking the two as extremes, it is perhaps safe to assert that the extinction of the falls, either by diversion into industrial power or by their cutting back to the upper lake, may be expected to be not likely to prove a burning question with this generation.

And yet, with a third of a million horse-power already practically preëmpted, with our forests disappearing, with a corner in the coal market already, and other strikes to come, and with the brink of the falls retreating with accelerated rapidity, it is possibly unwise to bank heavily upon that expectation. But, however this may be, the Falls of Niagara will surrender hundreds of thousands of horse-power in the current decade, and all this power will be distributed electrically and much of it employed in electrical processes of manufacture.

R. H. T.

SCIENTIFIC NOTES AND NEWS.

THE Desmazières prize of the Paris Academy of Sciences has been awarded to Professor Roland Thaxter, of Harvard University, for his study on the parasitic fungi of American insects.

THE Carnegie Institution has appropriated $4,000 to the Yerkes Observatory, to be expended under the direction of Professor George E. Hale, for certain researches in astronomy

and astrophysics. These will comprise: (1) A photographic investigation of stellar parallaxes by Dr. Frank Schlesinger, now in charge of the International Latitude Observatory at Ukiah, California. (2) Investigations in stellar photometry, to be made by Mr. J. A. Parkhurst. (3) A detailed study of several hundred photographs of the sun, taken with the spectroheliograph at the Kenwood Observatory in the years 1891–1896. Mr. Philip Fox, formerly instructor in physics at Dartmouth College, is assisting Professor Hale in this work. (4) Certain investigations in solar and stellar spectroscopy, to be undertaken by Professor Hale as soon as the new horizontal reflecting telescope, recently injured by fire, has been completed.

Professor Frederick W. Putnam, curator of the Peabody Museum, has been awarded the Lucy Wharton Drexel medal of the Franklin Institute of Philadelphia for his distinguished work in American archeology.

Commander Robert E. Peary, U.S.N., was elected president of the American Geographical Society, New York, at its annual meeting on January 27.

Professor E. B. Wilson, of Columbia University, has received leave of absence for the second half year, and will be at the Naples Zoological Station from February until July. During his absence the direction of the Department of Zoology at the university will be assumed by Professor Bashford Dean, to whom communications for the department should be addressed.

Dr. J. F. Newsom, associate professor of mining and metallurgy in Stanford University, has returned from a visit to the principal European schools of mining.

President H. S. Pritchett, of the Massachusetts Institute of Technology, is confined to the house by an injured knee, due to the fall of a horse that he was riding.

National Geographic Magazine (Washington) for February is authorized by Mr. William Ziegler, of New York City, to announce that he intends to send forth another north polar expedition this summer. The party will go north on the *America*. The personnel of the expedition is not yet complete, so that a list of the members can not now be given.

Mr. W. N. MacMillan, of St. Louis, with Mr. Isidore Morse, of Boston, and Colonel John Harrington, of the British Army, have started on an expedition to explore the course of the Blue Nile.

Professor R. H. Richards, of the Massachusetts Institute of Technology, has just completed a short course of lectures on ore-dressing, in which he set forth the results of his exhaustive study on this subject, at the Missouri School of Mines at Rolla, Mo.

Mr. Charles Francis Pidgin, chief clerk of the Massachusetts Bureau of Statistics, has been appointed chief of the bureau, to succeed Mr. Horace G. Wadlin, who has become librarian of the Boston Public Library.

Dr. Brouardel, honorary dean of the Paris Faculty of Medicine, has been presented with a plaque by his former students, engraved by M. Roty.

M. H. Poincaré, the eminent mathematician and physicist, has been made a commander of the Legion d' honneur.

Professor Robert Helmert, director of the Geodetic Institute of Potsdam, has been given the honorary doctorate of engineering by the Polytechnic School at Aix.

Mr. Herbert Kynaston has been appointed by the British Colonial Office director of the Geological Survey of the Transvaal.

The hundredth anniversary of the birth of Heinrich Daniel Rhumkorff was celebrated at Hanover on January 15. A tablet was placed on the house in which he was born and a new street was given his name. Professor W. Kohlrausch made an address on Rhumkorff's scientific work.

David Phillips Jones, chief engineer, U.S.N. retired, and formerly professor at the Naval Academy, died at Pittsburgh on January 30.

Mr. Elnathan Sweet, a well-known civil engineer, died at Albany, N. Y., on January 26, aged sixty-six years.

Dr. John O. Quantz, professor of psychology in the State Normal School of Oshkosh,

Wisconsin, died of heart trouble on Saturday, January 24. He was called to the position at Oshkosh about a year and a half ago. He was an able and accomplished scholar and an educator of great promise. His brilliant mind and scholarly achievements three times secured for him recognition in the way of fellowships from three American universities. For two years after graduating as honor man at Toronto he was fellow in psychology in the University of Wisconsin, which institution bestowed upon him the degree of doctor of philosophy in 1897. Clark University, Worcester, Massachusetts, then honored him with a fellowship for a year, and Cornell for the year following. He was born near Toronto, Canada, about thirty-five years ago. In his professional career he had gained a large circle of admiring and steadfast friends. T. L. B.

THE cablegram from Edinburgh which we quoted last week to the effect that Mr. Andrew Carnegie would establish with $5,000,000 an endowment for scientific research in Scotland is said to be without foundation. Under these circumstances we almost hesitate to quote the item in the daily papers this week to the effect that Mr. John D. Rockefeller will give $7,000,000 for the erection and endowment of a research hospital in connection with the Medical Department of the University of Chicago.

WE are sometimes compelled to quote from the daily papers announcements of gifts and endowments without assurance of their correctness, but we refrain from quoting medical discoveries, otherwise it would be necessary to announce cures for blood poisoning, hay fever and pneumonia, and the discovery of the bacillus of hydrophobia. The name given to the alleged bacillus of the latter disease reads as though it might be correct 'Coccus babyllus polymorphus lissac.'

Nature quotes from a German newspaper an item to the effect that Dr. Dohrn, of Naples, having appealed with little result to the German minister of education for financial aid in the extension of his world-famed biological station, sought an interview with the Kaiser. Remarking sympathetically that he could not provide all that Dr. Dohrn desired from his private purse, the Kaiser furnished him with a donation form, headed by himself and a contribution of £1000 commanding that it should be circulated among the leaders in Berlin society, for return to the Kaiser in person. The result was that within a few days the magnificent sum of £15,000 was subscribed.

THE new lion house of the New York Zoological Park was opened on February 2. It is said to be the finest building for this purpose in existence. The main corridor is 192 feet long, some of the cages, which are enclosed by netting instead of iron bars, being as large as 18 x 22 feet. The building includes a studio for artists with a special cage.

THE daily papers state that the University of Chicago has received from Sir William Van Horne of Montreal a collection of fossils valued at $30,000.

A LARGE collection of sea anemones from the coast of Chili has been examined for the Royal Museum of Berlin by Dr. J. Playfair McMurrich, professor of anatomy in the University of Michigan. Dr. McMurrich's report will be published in a future number of the *Zoologische Jahrbucher*.

ENGLISH papers state that Sir Ernest Cassel has offered to give £40,000 towards the study and investigation of ophthalmia in Egypt.

THE board of directors of the American Institute of Electrical Engineers has passed a resolution disapproving of the establishment on the part of N. Y. state of an electrical laboratory and standardization bureau.

TELEPHONIC communication has been established between Paris and Rome, which is the longest line in Europe, though it is surpassed in America. The distance from Paris to Rome is 1,593 km. and from Paris to Berlin 1,115 km.

UNIVERSITY AND EDUCATIONAL NEWS.

HARVARD UNIVERSITY receives $50,000 by the will of Rebecca C. Ames, the income to be used for the support of poor students.

The annual report of Provost Harrison shows that the University of Pennsylvania has received gifts during the year to the value of $936,851, and that the total value of gifts since 1895, when Dr. Harrison became provost, is $4,750,161.

A bill has been introduced in the senate of the state of California providing for a special procedure in court to confirm the legality of trusts for eleemosynary and educational institutions. It is understood that the bill has been introduced to enable Mrs. Stanford to divest herself of the control of the property left by her husband for Stanford University.

The Military Academy appropriation bill, carrying $644,273, was read and passed in the Senate on January 27, without amendment or debate.

The Thaw fellowship in astronomy in Princeton University is open for next year to a college graduate of not more than five years' standing. Inquiries may be addressed to the professor of astronomy or to the university registrar. Applications with proper credentials must be filed with the registrar before May 1.

The board of trustees of the New Mexico School of Mines has established a system of fellowships and scholarships in mining and geology. The first group will include ordinary fellowships, which are expected to yield $300 a year; and traveling fellowships, which are expected to yield annually $500 and $1,000. The scholarships are available this year. There are fifty scholarships, each yielding $100, open to students living in the United States. There is one scholarship for each state in the Union. The student from each state passing the best examination for entrance to the school, or to advanced standing, or furnishing evidence of best qualifications to carry on the work in this institution, is awarded the scholarship for that state. There are forty scholarships each yielding $25 a year, and open to students who are actually residents of New Mexico. They are good for one year; and are bestowed at the beginning of each academic year. These scholarships are awarded annually as honors. The main object sought in the bestowal of these honors is the encouragement of scholarship among those who wish to prosecute studies related to mining in the New Mexico School of Mines.

Early on Sunday morning, January 25, the College Chapel at Oberlin was completely destroyed by fire. It was the oldest building in use by the college and was built in 1854. The offices of the president, treasurer, secretary and registrar and the Y. M. C. A. reading room were on the first floor. The records and nearly all valuable papers were saved. The Old First Church will be used for chapel purposes, and the administration offices will be located in the power house until a new chapel and a new administration building can be provided. The insurance was only twenty thousand dollars.

The fifty-second anniversary of founder's day at Northwestern University was celebrated on January 28, when the new professional school building was dedicated. President Hadley delivered an address on 'The Place of the Professional School in the Modern American University.'

Dr. William E. Huntington, professor of ethics and history and dean of the College of Liberal Arts of Boston University, has been appointed acting president of the institution. A committee of the trustees has been appointed to recommend a successor to the Rev. William F. Warren. Dr. Warren has been guaranteed a salary of $2,500 during life and the chair he occupies in the school of theology has been given his name.

At Stanford University Edward C. Franklin has been appointed an associate professor in the department of chemistry, to succeed the late Professor George M. Richardson.

Dr. Oliver Dimon Kellogg has been appointed instructor in mathematics at Princeton University.

Dr. Th. Descoudres, associate professor of theoretical physics at Wurzburg, has been called to Leipzig.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 13, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION F, ZOOLOGY.

SECTION F was organized at the Washington meeting on December 29, 1902, with the following officers:

Vice-President—C. W. Hargitt.

Secretary—C. Judson Herrick.

Fellow Elected to the Council—Charles L. Marlatt.

Sectional Committee—C. W. Hargitt, Vice-President, Washington meeting; C. Judson Herrick, Secretary, Washington meeting; C. C. Nutting, Vice-President, Pittsburgh meeting; C. W. Stiles, Secretary, Pittsburgh meeting; C. L. Edwards, to serve one year; H. F. Osborn, to serve two years; S. H. Gage, to serve three years; C. H. Eigenmann, to serve four years; H. B. Ward, to serve five years.

Member to General Committee—Herbert Osborn.

Meetings of the section for the reading of papers and other business were held on December 29, 30, 31 and January 1.

At a joint meeting of the section with the American Society of Zoologists, December 30, it was '*Resolved,* That it is the sense of this meeting that the *Concilium Bibliographicum* of Zurich is of the greatest value to zoologists, and it is recommended to the Carnegie Institution for financial assistance.'

The following papers were presented before the section:

Tadpoles of the Green Tree Toad (Hyla versicolor) and Comparison with the Common Toad (Bufo lentiginosus): Simon H. Gage, Cornell University.

The most obvious, although by no means the most important, change in transformation is the disappearance of the tail. Comparing the common and the tree toad, it was found that in the tadpoles of the common toad the tail shortened 4.6 mm. in 24 hours, while that of the tree toad shortened 24 mm. in 24 hours, or more than five times as rapidly as the common toad. Although the common toad is considerably larger than the tree toad, the tadpoles of the latter are much the larger—that is, from two to three times the length from tip to tip. If one compares the percentage of the total length which disappears in the two cases, it is found that in *Bufo* the diminution is 25.5 per cent., while in *Hyla* it is 47 per cent. in 24 hours. That is, the relative as well as the absolute amount of shortening is greater in the tree toad in a given time.

In coloration the common toad tadpoles are entirely black or barred. The small tadpoles of *Hyla* are less deeply pigmented, but of nearly a uniform shade. As the tadpoles approach their greatest perfection as tadpoles, the coloration assumes a brilliant red, mottled with black. This makes them very conspicuous. The appearance is especially striking when the sunshine is strong. When transformation approaches, the green color so characteristic of younger tree toads appears on the body, and the red may become less brilliant in the tail, but often that remains and the animal is brilliant in red and green.

Every effort to get at the meaning of this coloration in the tadpoles was unsuccessful. It can not be for attraction, as the animals are immature. It can not be for protection, as there are no similarly colored objects in the water. It can not be a warning color, as the animals are readily eaten by animals living more or less on tadpoles.

The Habits of Cryptobranchus: Albert M. Reese, Syracuse University, Syracuse, N. Y.

Cryptobranchus alleghaniensis, or hellbender, occurs in great numbers in streams of the Ohio valley, but is apparently seldom found outside of that region. It sometimes reaches a length of 60 cm., and though it is a repulsive looking animal, and has the reputation among fishermen of being poisonous, it is really a most harmless and inoffensive creature.

Respiration in the adult is by means of well-developed lungs, but there is a persistent gill-opening on each side of the throat. Air for respiration is taken in by a curious swallowing motion, and is exhaled partly by a quick expiration, when the animal comes to the surface to breathe, and partly by bubbles set free as the animal lies on the bottom. In captivity, the respiration intervals seem to be quite variable, the average length of time between inspirations being about 15 minutes, the longest recorded interval being 43 minutes.

Under natural conditions, the hellbender seems to be a remarkably voracious animal, living chiefly on small fish, crayfish, etc., but in captivity its appetite is quite moderate, a few small pieces of raw liver once or twice a week being all that it will eat in the summer, while in the autumn several specimens kept under observation in a tank refused to eat during a period of over two months. One morning at the end of this long voluntary fast, a black object was seen projecting from the mouth of a large hellbender which, on closer examination, proved to be the tip of the tail of a smaller individual which had been swallowed head first. By means of forceps the small hellbender was rescued from his strange pre-

dicament, and immediately swam away, none the worse for his terrible experience. Even after this apparent evidence of returning appetite, the hellbenders ate but little of the liver that was given them. Their remarkable tenacity of life is shown by the fact that an individual that escaped from the tank lived for three weeks without food and water.

Nothing was learned as to the breeding habits except the fact that they will not breed in captivity, unless, perhaps, they are captured just before their natural spawning season.

Sense of Hearing in Fishes: G. H. Parker, Harvard University, Cambridge, Mass. To be published in *Bull. U. S. Fish Commission.*

The presence of an internal ear in fishes led Hunter, Müller, Owen and other physiologists to ascribe hearing to these animals. The fact that after the loss of the ear fishes lose their equilibrium, but still respond to sound waves if intense enough, led Kreidl and especially Lee to conclude that the internal ears of fishes were for equilibration and not hearing, and that sound waves stimulate the skins of fishes, not their ears. Fishes, therefore, feel sounds, but do not hear them. *Fundulus heteroclitus,* after having had the nerves to its integument and to its lateral line organs cut, thus rendering its skin insensitive, still responds by fin movements to sound waves, but ceases so to respond after the nerves to the internal ears are cut. *Fundulus heteroclitus,* therefore, responds to sound waves through the ear—that is, it hears.

Breeding Habits of the Yellow Catfish (Ameiurus nebulosus): Hugh M. Smith. To be published in *Bull. U. S. Fish Commission.*

This paper is based chiefly on observation of a pair of fish from the Potomac River in the Fish Commission aquarium at Washington. They made a nest on July 3, 1902, by removing in their mouths upwards of a gallon of gravel from one end of the tank, leaving the slate bottom bare. On July 5 about 2,000 eggs, in four separate agglutinated clusters, were deposited between 10 and 11 A.M. on the scrupulously clean bottom. Ninety-nine per cent. hatched in five days in a mean water temperature of 77° F. The young remained on the bottom in dense masses until six days old, when they began to swim, at first rising vertically a few inches and immediately falling back. By the end of the seventh day they were swimming actively and most of them collected in a school just beneath the surface, where they remained for two days, afterwards scattering. They first ate finely-ground liver on the sixth day, and fed ravenously after the eighth day. The fish were 4 mm. long when hatched, and grew rapidly, some being 18 mm. long on the eleventh day, and at the age of two months their average length was 50 mm.

Both parents were very zealous in caring for the eggs, keeping them agitated constantly by a gentle fanning motion of the lower fins. The most striking act in the care of the eggs was the sucking of the egg-masses into the mouth and the blowing of them out with some force. The fanning and mouthing operations were continued with the fry until they swam freely, when the care of the young may be said to have ceased. During the first few days after hatching, the fry, banked in the corners of the tank, were at irregular intervals actively stirred by the barbels of the parents, usually the male. The predaceous feeding habits of the old fish gradually overcame the parental instinct; the tendency to suck the fry into their mouths continued and the inclination to spit them out diminished, so that the number of young dwindled daily and the 500

that had been left with their parents had completely disappeared in six weeks, although other food was liberally supplied.

The Effect of Low Temperatures on Mosquito Larvæ: John B. Smith, New Brunswick, N. J. To be published in Final Rep. of Mosquito Investigation, N. J.

Mosquitoes were, until recently, supposed to hibernate as adults, and it was believed that low temperatures checked or absolutely prevented the development of larvæ.

A series of observations made in New Jersey during the winter of 1901–02 and the last months of 1902 indicate that even freezing temperatures do not entirely prevent development, though they may delay it. The species vary in method of hibernation, some living through as adults, some as larvæ, and some in the egg stage. None winter as pupæ. The larvæ that hibernate may be frozen solidly in ice and will come to no harm. Temperatures down to zero (Fahrenheit) do not prevent final maturity, and the freezing and thawing may be repeated several times during the winter without bad effects.

Of species that hibernate as adults, many larvæ of the later broods are caught by frosts and may be ice-bound for a time without harm. The larvæ of *Culex pungens* have been observed in a pail coated with ice one fourth inch thick, barred absolutely from access to the outer air for several hours, and they completed their development in due time after the ice disappeared. Pupæ of the same species have been frozen in a solid mass of ice and transformed into adults later.

Concerning *Anopheles punctipennis* the same observation has been made, and both larvæ and pupæ were taken from pools that had been completely ice-coated for several hours.

Species which in the larval stage have survived freezing, or at least being bound in ice-covered pools, are *Anopheles punctipennis, Culex canadensis, Culex sylvestris, Culex pipiens, Culex restuans, Culex territans, Aedes smithii* and *Corethra brakeleyi.* Of *Aedes smithii* it is positively known that it winters in the larval stage only; of *Anopheles punctipennis* and *Culex pipiens* it is positively known that they winter as adults only. Of *C. canadensis* and *C. sylvestris* it is believed that they winter in the egg stage; but it is not certain that they do not also winter as larvæ. Of *C. territans* it has been said that it winters as an adult, but the larvæ are found very late in winter and very early in spring.

Notes on the Natural History of Some of the Nudibranchs: W. M. Smallwood, Syracuse University, Syracuse, N. Y. To be published in *Bull. Syracuse University.*

During the past summer at Woods Holl the following nudibranchs were secured: *Montagua gouldii, Montagua pilata, Doris bifida, Æolis papillosa* and *Elysia chlorotica.* The classification is according to Verrill.

Montagua gouldii was found in large numbers in the colonies of *Tubularia crocea. Montagua pilata* was taken by dredging. *Doris* and *Æolis* were found at low tides on rocks and weeds. *Elysia* was taken in a tow-net, but did not lay while under observation; the other forms laid very freely in common glass aquaria.

One hundred and fifty specimens of *Montagua gouldii* laid 929 masses of spawn within nine days after being brought into the laboratory, and hundreds of egg masses might have been collected from the hydroids from which these were taken. The spawn was scattered or laid in nests;

it is small and fan-shaped, containing about 500 eggs.

The ends of the oviducts in the copulation of *M. pilata* become firmly united, so that the animals may be pulled about with considerable freedom. While in copulation the swollen ends of the oviducts are spherical in form and the color is intensified. It may take three hours for the distended oviduct to become completely retracted. The egg mass is laid in the form of a straight or undulating string frequently six inches long. There are from two to eight eggs in a single section of the string. Deposition occurs from twelve to twenty-four hours after copulation.

The spawn of *Doris* is long and ribbon-like, one fourth of an inch wide. The eggs are arranged in regular rows at right angles to the long axis of the spawn mass.

Æolis papillosa lays about forty separate, oval, salmon-colored egg masses, all of which are united into one large, gelatinous mass.

Death-feigning in Sand Fleas: S. J. Holmes, Ann Arbor, Mich.

Death-feigning in the large sand-flea, *Talorchestia longicornis,* is a pronounced instinct. This species is nocturnal in its habits, and during the day lies curled up in its burrows in the sand in a condition apparently much like the sleep of higher animals. When dug out of its burrows, *Talorchestia* may remain curled up and motionless, or it may assume such a condition after a few hops in the sand. In assuming the death-feigning attitude, *Talorchestia* flexes its body, draws up its legs, and bends its antennæ under the thorax. It will then remain motionless, often for a long time, and may usually be picked up without betraying any evidence of animation. The utility of such an instinct is obvious, as it enables its possessor to escape detection. By lying quiet in the sand, which it closely resembles in color, *Talorchestia* would easily be overlooked by predatory birds and mammals, whereas if it endeavored to escape by hopping away, its large size would render it an easy victim.

The terrestrial amphipods form a group which has only recently adopted the habit of living upon land. The instinct of death-feigning is, therefore, one of recent origin, as it is one which has doubtless been acquired in adaptation to the habit of living above water on sandy beaches. We naturally look to the behavior of the aquatic relatives of this species and of other terrestrial forms for light upon the origin of this instinct. Two other species found on the New England coast, *Orchestia palustris* and *O. agilis,* fortunately exhibit intermediate modes of behavior which connect the death-feigning instinct of *Talorchestia* with the so-called thigmotactic reactions of the aquatic amphipods. Nearly all the littoral species of aquatic amphipoda manifest a strong propensity to keep in contact with solid objects. When free from contact they are restless. They usually endeavor to insinuate themselves between objects, so as to secure a maximum of contact; then they lie quiet, usually with the antennæ bent back and the body flexed.

The behavior of the two species of *Orchestia* studied shows that they possess certain fundamental features of conduct in common, and that the death-feigning of *Talorchestia* is nothing but an exaggeration and specialization of the thigmotactic proclivity which these forms share with the aquatic amphipoda.

Variation and Natural Selection in Lepidoptera: H. E. Crampton, Columbia University.

The relation between the process of

elimination and variation in *Philosamia cynthia* was first considered. It was shown that pupal elimination is directly related to variation, selection being 'secular' (with reference to type) as well as 'periodic' (with reference to variability). *Samia cecropia* exhibits only periodic selection. Reproductive selection appears clearly in *Samia cecropia*.

The Tortugas as a Biological Station for Research: Alfred G. Mayer, Museum of the Brooklyn Institute of Arts and Sciences.

The Tortugas occupy what is probably the most favorable situation from which to study the tropical life of the Atlantic Ocean. Extensive coral reefs surround the islands, and in the immediate neighborhood one finds reef flats, sandy bottoms, coral mud and a great variety of habitats for a rich and varied fauna. Pure deep ocean water surrounds the group, and their separation from the Florida coast is sufficient to prevent the impure water of the mangrove swamps from contaminating the ocean water of the Tortugas. It is, therefore, possible to maintain larvæ alive for many weeks in aquaria. The temperature of the surface waters in the immediate vicinity of the Tortugas is remarkably high, being from 74° to 77° in winter and 80° to 86° in summer. It is, therefore, warmer than any other part of the Atlantic Ocean, excepting the Bight of Biafra, and is almost identical in temperature with the waters surrounding the Fiji Islands. The northern edge of the Gulf Stream lies about twenty-five to thirty miles south of the Tortugas, but the prevailing easterly and southerly winds of the spring and summer months drive the surface waters of the Gulf Stream upon the shores of the Tortugas, thus drifting in great numbers of pelagic animals, which cause the surface tows to be richer in this region than at any other place known to the writer, and comparable only to the condition observed in the region of the Kuroshiwo, in the neighborhood of the Philippine Islands.

The pelagic fauna of the Tortugas contains representatives from the coast of Africa and from the entire tropical Atlantic, and is in general remarkably similar to that of the Fiji Islands, although specific distinctions between related forms of Fiji and Tortugas can usually be determined. This close relationship is probably due to the similarity of the temperature and the conditions of the reefs.

The fauna of the Tortugas is strictly tropical. Its special advantages over any station on the Florida coast are purity of the water and the richness of the fauna. In these it appears to be superior also to the West Indies, the Bahamas, and very much richer than the Bermudas. The climate is healthful, and although in the summer months the humidity is very great, it is possible to maintain perfect health and energy throughout the hot season. The recent establishment of a naval coaling station at the Tortugas has made it easily accessible from Key West.

The Phasmidæ, or Walking-sticks of the United States: A. N. Caudell, U. S. National Museum. To be published in *Proc. U. S. Nat. Mus.*, Vol. XXVI., 1903.

This paper gives, in monographic form, tables for the separation of the Phasmidæ into subfamilies, genera and species, only the forms of North America north of Mexico being included. A few prefatory paragraphs are given bearing upon the nature and habits of the species composing the family. Four subfamilies are recognized, one, Timeminæ, being described as new, based upon a very remarkable forficulid-like form from California. Three genera and as many species are described

as new and one species, *Timema californicum,* first mentioned by Professor Scudder some years ago, is here described for the first time. Four plates are given, illustrating species of all the genera.

The Morphology of Clasping Organs in Certain External Parasites: HERBERT OSBORN, Ohio State University.

The adaptations of parasitic animals afford numerous striking cases of structural specialization, and in this paper certain highly modified organs for adherence in Pediculidæ are described and their homologies discussed. In *Hæmatopinus urius* there is a protractile disk on the distal end of the tibia, which from its position must be applied to the hair opposite the tarsal claw. In *Hæmatopinus macrocephalus* an organ in the same position has more convex membranous surface, and distinct internal muscles. In both the disk and the spines on its border evidently arise from the chitinous wall, but their musculature is problematic. In *Euhæmatopinus abnormis* the posterior legs are greatly modified, the femur and tibia each with expanded disk, the former opposed to the middle femur and the latter to a special structure in the margin of the abdomen, both evidently serving to strengthen the grasp on hairs or fur, or to give greater rigidity in position. Other special structures are noted in antennal joints, in abdominal brushes, ridged tarsi, etc.

Description of Four New Species of Grasshoppers, and Notes on Other Orthoptera from Colorado, Texas, Arizona and New Mexico: A. N. CAUDELL, U. S. National Museum. To be published in *Proc. U. S. Nat. Mus.*, Vol. XXVI., 1903.

This paper treats of more than 150 species of Orthoptera, mostly collected in Colorado during the summer of 1901 by Dr. H. G. Dyar and the writer, though species from the other states mentioned in the title are included. The location and altitude of the various places visited in Colorado are given, and every species taken is listed, if only for the value attached to records of exact locality. Many of the species are represented in considerable numbers and thus present opportunities for studies in variation. Four new species are described, and two species of Blattidæ are recorded for the first time from the United States. One plate is given, comprising figures of the new species.

An apparently unrecorded fact regarding the large lubber grasshopper of the South, *Dictyophorus reticulatus* Thunberg, is noted. Both sexes of this brightly colored insect make a distinct simmering or bubbling sound when disturbed. This sound was found to proceed from a gland, probably a modified spiracle, opening from the side of the body above and slightly behind the middle coxa. The sound is made by the insect's forcing out very minute bubbles of a clear liquid with sufficient force to cause a sound capable of being heard for some distance. Whether this liquid has repelling properties and the resulting sound is purely mechanical, or whether the production of sound is the object of the mechanism, was not determined. The conspicuous warning colors of the insect would rather indicate the former supposition.

The Colorado collection seems to indicate the existence of but three faunal zones in that state instead of four, as indicated by the lepidopterous fauna as pointed out by Dr. Dyar in the *Proceedings of the United States National Museum* (XXV., 369, 1902). The Orthoptera show no distinct indication of a separate faunal zone on the western slope.

A Review of Certain Attempts to Introduce the Eastern Oyster into the Bays on the Oregon Coast: F. L. Washburn, State Entomologist, St. Anthony Park, Minn.

Encouraged by the reported finding of eastern spat in abundance in San Francisco Bay in 1890, it was resolved by the state authorities in Oregon in 1896 to attempt to induce the eastern oyster to propagate in the bays of the Oregon coast, and to that end an appropriation was secured in the legislature, as was also the cooperation of the United States Fish Commission. The work was in charge of the state biologist. In 1896 twenty-two barrels of two-year-old oysters, and in 1900, ten barrels, were shipped from New York state. The first of these consignments was on the road twelve days, and the second eight days, but the oysters nevertheless arrived in excellent condition, the loss not exceeding a fraction of one per cent.

Various means were resorted to to make a success of the experiment. The oysters were placed upon a portion of ground which is a natural bed for the native northwest coast oysters, and where abundance of food could be obtained. Artificial fertilization was practiced and millions of fertilized eggs were poured into the bays at different times. Oysters were placed in floats and artificial ponds, and in cemented tanks; in fact, nothing was left undone which was within the power of the biologist. Little or no results came from these experiments. The strong, cold northwest wind which prevails almost every day in summer on the northwest Pacific coast not only chills the surface of the water of the bays, but appears to force into all the inlets an immense amount of ocean water which has an average summer temperature of about 55° F. and a salinity of 1.025. The water in all the bays of Oregon is quite cold on the flood tide, the writer having seen it change from 70° F. and a density of 1.016 at low tide to 57° F. and a density of 1.022 at high tide within six hours, and this at a distance of seven miles from the ocean. These conditions of temperature and salinity and such marked changes are all unfavorable for the developing spawn. Only one or two specimens have been found which were undoubtedly hatched on that coast.

Although these experiments in propagation were a failure, the transplanted oysters attained an immense size in a short time, and were all of such excellent quality that the importation and fattening for sale of eastern oysters in the markets of the northwest coast offer inducements to capital.

Some Recent Cytological Investigations in their Bearing on Mendel's Principles of Heredity: E. B. Wilson, Columbia University.

Abstract of this paper has appeared in Science, N. S., XVI., No. 416, December 19, 1902.

Provisional Program for Continuation of Researches on Cave Fauna: C. H. Eigenmann, Indiana University.

A Reconnaissance of Faunal Conditions in Jamaican Waters: Hubert Lyman Clark, Olivet, Mich.

Report of a recent visit to Jamaica, including: (1) Observations of echinoderms, (2) variation in the genus *Stichopus,* and (3) an apparently new parasitic turbellarian.

The three preceding papers were read at a joint session of Section F and the American Society of Zoologists.

On a Small Collection of Crustaceans from the Island of Cuba: William Perry Hay, Howard University, Washington, D. C. To be published in *Proc. U. S. Nat. Museum.*

The paper contained notes on a collection of crustaceans from the caverns and coastal streams of Cuba submitted to the author by Dr. C. H. Eigenmann, of the State University of Indiana. There are altogether fourteen species, of which three —*Cirolana cubensis, Palæmonetes eigenmanni* and *Palæmonetes cubensis*—are new to science.

Cirolana cubensis and *Palæmonetes eigenmanni* are spelean species exclusively and have the usual characteristics of such forms—they are slender, transparent and blind. Full descriptions and figures of the new species were given. Under the notes on *Cambarus cubensis,* attention was called to some rather unusual characters shown by the specimens collected by Dr. Eigenmann which may by future work be shown to mark a distinct species.

The collections were made in the early spring of 1902, through the assistance of a grant of money by the American Association for the Advancement of Science.

Evolution of the Proboscidea in North America: H. F. OSBORN, American Museum of Natural History, New York city.

From the oldest certainly known form, *Palæomastodon* of Egypt, through the Lower Miocene *M. angustidens* of Europe, the Proboscidea migrated to America. In the Middle Miocene at least three and possibly four contemporary phyla appear in this country. The first phylum, distinguished (1) by laterally compressed upper tusks, (2) short lower tusks, (3) narrow molars with a single trefoil, includes the Middle Miocene *M. productus* Cope and the Upper Miocene and Pliocene *M. floridanus* Leidy, *M. obscurus* Leidy, *M. tropicus* Cope, *M. serridens, M. rugosidens* and possibly *M. præcursor* Cope. The second phylum, with (1) round upper tusks and (2) a double trefoil on long narrow molars, includes the Upper Miocene *M. campester* Cope and possibly *M. humboldtii* of South America, a Pliocene or Pleistocene form. The third phylum, distinguished by (1) long lower tusks, with enamel in the early stages, (2) laterally compressed upper tusks, (3) short posterior molars, includes *M. brevidens* Cope (the oldest species known in North America), *M. euhypodon* Cope from the Upper Miocene and possibly *M. shepardi* Leidy from the Pliocene. In the Pliocene appears the highly specialized *M.* (*stegodon*) *mirificus* Leidy, with (1) round upper tusks, (2) double trefoil, (3) only four grinding teeth altogether. This may connect with the *M. campester* series, or it may represent a new arrival from Europe. The early Pleistocene includes two superb elephants, *E. columbi* of the Middle and Southern States, and *E. imperator* of the Southwest. Both these species can now be clearly distinguished from the true northern mammoth, *E. primigenius.* The paper is illustrated by numerous drawings and photographs. Acknowledgments were made especially to Mr. F. A. Lucas.

Primary Division of the Reptilia into Two Great Groups Phylogenetically Distinct: HENRY F. OSBORN and J. H. MCGREGOR, Columbia University. Presented by Henry F. Osborn; will be published elsewhere.

Some Questions as to the Arrangement of the Primates: B. G. WILDER, Cornell University.

This paper embraces four parts:

(*a*) A provisional dichotomous arrangement of the Primates in which the main stem, terminating in man, gives off branches representing successively the lemurs, the marmosets, the New World monkeys, the Old World monkeys, the gibbons and the giant apes. Of this last group one subdivision includes the two African apes, the gorilla and chimpanzee,

and the other the orang. The general principle of dichotomy was followed by the author with respect to the entire animal kingdom in a paper before this association in 1887, and is believed by him to be equally applicable to the primate order.

(*b*) But questions and difficulties arise in connection with all the divisions. For example, the extinct *Pithecanthropus* is not included, and there is no hint of the possibility of a closer affinity between *Tarsius* and the tailless apes. As to the latter, the less divergence of the gibbons from the tailed monkeys has been urged by Chapman, but he regards the gibbons and orang as 'closely related,' whereas the present arrangement, mainly on cerebral grounds, places the orang nearer man than either the gorilla or the chimpanzee.

(*c*) The author believes that, eventually, all the divisions and subdivisions may be based upon encephalic characters alone, but at present, even where the brains are recognizably different, it is not always possible to formulate the distinctions.

(*d*) In order to determine the validity of this belief, it is necessary to compare the brains of all genera and if possible all species, and several of each. One of the author's graduate students, Mr. T. L. Hankinson, spent most of last year in the effort to determine the fissural differences between the Old and New World monkeys, but his appointment to a college position has interrupted the work for the present. Among the genera of which more examples are desired are *Hylobates, Nasalis, Semnopithecus, Colobus, Brachyteles, Pithecia, Brachyurus, Nyctipithecus* and all lemurs.

Male Preponderance (*Androrhopy*) *in Lepidopterous Insects:* A. S. Packard, Brown University.

Eimer ('On Orthogenesis,' etc., 1898) calls attention to what he calls the 'law of male preponderance,' or the fact that the male is ordinarily a step or so in advance of the female in expressing the direction of development, and then transmits in a certain measure his characters to the species. This, he adds, may occur exceptionally in females, so that there is a law of female preponderance. He takes his examples from the markings of *Papilio,* of lizards and of birds of prey.

There are numerous cases among other lepidoptera than butterflies. Male preponderance, as we understand it, is a general law of animal life. The female is the conservative sex, the male, as is well known, the more variable, the more active and aggressive, and the founder of new structures or markings characterizing new varieties and species.

For the principle of male preponderance we would propose the term *androrhopy* ('ανδρειος, male; ῥοπη, preponderance), and when female preponderance exceptionally occurs, it might be called *gynerhopy* (γυνή, female; ῥοπη, preponderance).

Very obvious examples of androrhopy occur in the Saturniidæ. In this group the females have aborted mouth-parts, they are very heavy and sluggish, inactive, flying, if at all, but a short distance from their birthplace. On the other hand, the male is more active and energetic, will fly for miles in search of the female, guided by the odor emanating from her body. The male is thus exposed to a greater variety of environmental conditions. An example is seen in the genus *Saturnia* (*i. e., S. pavonia-minor*) of male divergence from the form and markings of the female; otherwise gynerhopy prevails in this genus.

In the tailed forms, especially the group represented by *Graëllsia, Arzema, Actias,* and *Tropæa,* the effects of the inheritance of male characteristics is seen to have af-

fected this whole group. Comparing the two sexes of the primitive form of *Graëllsia* with their hind wings briefly tailed, the males have much the longer 'tails.' In *Actias selene* the tails are nearly of the same length in both sexes, but in *Tropæa luna*, perhaps the most recent form of the group, the tails in the male are decidedly longer than in the other sex. In *T. artemis* of Japan there is a tendency to revert to the *Graëllsia* form of tail, as they are very short. The principle is seen also in regard to the markings and coloration in general.

From the prepotency of the male of some ancestral form similar to this insect, the tailed forms of the large green moths living in Africa, Asia, and our American *Tropæa luna* may have originated.

Other striking examples of androrhopy are seen in the moths of an allied group (Sphingicampidæ), such as *Arsenura, Eudelia*, etc. This does not conflict with the apparent fact that the length of the tails of species of *Papilio* seems to depend on temperature, those living in boreal, cool, moist situations, or in cool, damp, elevated, mountainous regions, having the tails much shortened.

The Decapod Crustaceans of the Northwest Coast of America from Alaska to San Diego, California: MARY J. RATHBUN, United States National Museum, Washington, D. C.

This paper, which will be published among the results of the Harriman Expedition, embraces not only the material derived from that expedition, but the collections in the U. S. National Museum which have been obtained in the same region from the work of the U. S. Fish Commission steamer *Albatross*, the Coast Survey and other explorations. It includes a check-list of the Decapoda of the region, figures of many of the little-known forms, and much new information concerning them, especially as regards distribution.

Further Notes on the Heart of Molgula manhattensis Verrill: GEORGE WILLIAM HUNTER, Jr., New York city.

Research by means of the intra-vitam method of staining with methylene-blue points to a connection between the ganglion cells of the heart and those of the central nervous system. The course of the connectives is as yet not fully worked out.

The following physiological data seem to point to this connection in animals in which the ganglion or dorsal nerve chain is partly or wholly destroyed:

(*a*) The heart beat (variable within limits) is appreciably slower.

(*b*) A lack of coordination between the two ends of the heart appears.

(*c*) There is sometimes great irregularity in the heart rhythm.

(*d*) The heart beats on occasions for from two to three hours in a given direction without reversal. (The normal heart usually reverses every one to two minutes.)

Certain substances (caffein, muscarine, nicotine, strychnine, *et al.*), heart depressors or accelerators, which are believed to act upon nerve cells or endings in the heart or in the sympathetic system of vertebrates, act in a similar manner upon the normal heart of *Molgula*. In the cauterized animal, however, no such results are obtained.

On the Morphological and Physiological Classification of the Cutaneous Sense Organs of Fishes: C. JUDSON HERRICK, Denison University, Granville, Ohio.

The proper interpretation of these sense organs has heretofore not been possible, because the problem has not been approached with sufficient breadth of view. Taking into account structure, innerva-

tion and function as experimentally determined, we may classify as follows:

I. Organs of the general cutaneous system. Free nerve endings of tactile nerves.

II. Organs of the acustico-lateral system. Peripheral organs neuromasts, with hair cells among indifferent cells, the former extending only part way through the sensory epithelium. Innervation by nerves centering in the tuberculum acusticum and cerebellum. They present the following varieties:

1. Canal organs, regularly arranged in canals in the dermis or dermal bones, which communicate by means of pores with the outside. Function, perception of mechanical jars and maintenance of equilibrium.

2. Pit organs, similar to the last, but each in a separate pit. In lines.

3. Small pit organs, smaller than the last and irregularly distributed.

4. Ampullæ. Organs at the bottom of long slender tubes. Only in Selachii.

5. Vesicles of Savi. Closed vesicles, only in the torpedoes.

6. Cristæ acusticæ. In semicircular canals of all vertebrates. Function, equilibration (reaction to rotary movements).

7. Maculæ acusticæ. In sacculus and utriculus. Function, equilibration (reaction to translatory and static stimuli?) and hearing (?).

8. Papilla acustica basilaris. In organ of Corti. Function, hearing (does not occur in fishes).

III. Organs of the communis system. Special organs with the specific sensory cells extending through the whole thickness of the sensory epithelium. Present in the mouth of most vertebrates and in the outer skin of some ganoid and teleostean fishes. Innervation by communis nerves; primary cerebral centers gray matter associated with the fasciculus communis (= f. solitarius), represented by the vagal and facial lobes of fishes. Function, taste. Two forms, differing only in position.

1. Taste buds, within the mouth.

2. Terminal buds, in the outer skin, often on barblets or other specialized organs for their reception.

Observations on Footprints in Beach Sand: HERBERT OSBORN, Ohio State University, Columbus, Ohio.

The observations recorded represent occasional studies during three summers on sand of Cedar Point Beach and adjacent dunes. Photographic records have been secured of as many of these as it has been possible to identify with certainty, and a few others of particular interest or rarity. The camera was adjusted to a vertical position by the use of a brass plate bent at right angles, and the best results were secured in the latter part of the afternoon, when oblique rays of the sun cast strong shadows in the tracks. Lantern slides from the photographic records, including *Hesperomys leucopus, Ardea herodias, Eurenetes pusillus, Emys meleagris, Coluber vulpinus, Heterodon platyrhinus, Bufo lentiginosus* var., *Microbembex monodonta, Trimerotropis maritima, Fontaria indianæ* and *Myrmeleon* sp. were shown and their characters described.

Such records are serviceable in determining the presence of particular animals in a given region, as presenting an interesting feature in the biology of the animal, and as a basis for comparison in studies of the imprints left by extinct animals.

An Exhibit of Lantern Slides Illustrating the U. S. S. 'Albatross' and her Work: C. C. NUTTING, University of Iowa.

Lantern slides taken by the author during the recent Hawaiian cruise, accompanied by an informal account.

The Eyes of a Specimen of the Cuban Blind Fish, Lucifuga, and those of Her Four Young (with lantern slide illustrations): C. H. EIGENMANN, Indiana University.

Faunal Characteristics of the Sandusky Region: HERBERT OSBORN, Ohio State University, Columbus, Ohio.

The Sandusky region as here defined includes parts of Erie, Sandusky and Ottawa counties, Ohio. Practically all the faunal elements of the region are to be found within five miles of the city of Sandusky. A brief summary of faunæ represented and the faunal conditions afforded is given, with illustrations in different groups. The region includes a lowland and partially timbered area of rather rich vegetation and diverse fauna; a beach and sand-dune fauna; a swamp and marsh fauna; a fauna pertaining to rocky coast and island, and one peculiar to a prairie area, approaching plains conditions in scant flora; aquatic faunæ pertaining to bay, coves, river and lake, with abundant plankton, nekton and littoral elements.

Protoplasmic Old Age: GARY N. CALKINS, Columbia University, New York city.

The 'A series' of *Paramœcium* experiments died out December 19, 1902, in the 742d generation. The last few individuals were perfectly normal so far as size, feeding, etc., were concerned. The history of the series tends to the conclusion that there is a definite potential of dividing energy which is possibly connected with a definite substance of the cell—archoplasm or kinoplasm.

The Structure, Development and Function of the Torus longitudinalis of the Teleost Brain: PORTER EDWARD SARGENT, Cambridge, Mass.

Morphology.—The torus longitudinalis, as typically developed, consists of a pair of longitudinal ridges or pads projecting downward from the thin median portion of the mesencephalic roof and extending from the posterior commissure through the length of the mesencephalon. The form and relative size of the torus, and consequently its relations to the surrounding structures, vary greatly in the hundred or more species examined.

Ontogeny.—The torus longitudinalis is developed from the roof of the mesencephalon as a longitudinal thickening of its median portion. More exactly, each lateral lobe of the torus is differentiated from the mesal edge of the tectum of the corresponding side, the precise mode differing somewhat in the different groups of teleosts.

Finer Anatomy.—Each lobe of the torus has a framework of radiating ependymal fibers. The nerve cells are of relatively small size, and frequently are arranged in parallel rows between the ependymal fibers. The cells are usually bipolar, but ultimately give rise to three sets of neurites. The first forms the tractus torotectalis, which runs into the tectum and ends in the superficial fiber zone in contact with the retinal fibers of the optic nerve. Another set of fibers passing out of the torus with the preceding forms the tractus toro-cerebellaris, which courses obliquely around the lateral border of the optic lobe and enters the cerebellum. The third set of neurites forms the tractus torofibræ Reissneris, which enters the ventricle in separate fascicles, there becoming united to form the compact fiber tract known as Reissner's fiber.

Function.—The cells of the torus are, then, in connection by their afferent neurites with the endings of the optic nerve, and by their efferent neurites with the body musculature through Reissner's fiber. It is evident, therefore, that the torus longitudinalis is the nerve center for the receipt of those impulses coming in over

the optic nerve which call for quick reflexes.

Homology.—It follows, then, that the cells of the torus longitudinalis constitute a nidulus of cells of common function, homologous with cells of similar function which occur in the anterior dorsal portion of the optic lobes of other vertebrates, and which have been designated as the 'Dachkern,' 'nucleus magnocellularis,' etc.

Phylogeny.—The nidulus of cells which gives rise to Reissner's fiber and constitutes the torus longitudinalis of teleosts is one of the most archaic elements of the vertebrate brain. As an independent structure, however, the torus has its beginnings in the ganoids, resulting from the crowding downward of the nucleus magnocellularis so as to form two incipient longitudinal ridges on either side of the median plane. In the Siluridæ, mechanical causes are still operative, but in the more highly differentiated teleosts the torus appears at an early stage of ontogenetic development as the result of phylogenetic causes.

An Unusual Attitude of a Four-weeks Human Embryo. Comparisons with the Mouse: Susanna Phelps Gage, Ithaca, N. Y. Illustrated by wax models. To be published in the *Journal of Anatomy.*

1. The specimen cut in the membranes shows the body axis lying in two planes at right angles to each other, the torsion occurring in the neck region. The attitude suggests: (*a*) that the great growth of the heart and the umbilical region on the left may have produced the torsion mechanically; (*b*) that the pulsations of the heart have produced a passive rotation, or (*c*) that the rapidly developing muscle cells may already at this early stage have a slight power to produce motion.

2. A very early mouse embryo—that is, with nine myotomes—shows a sharp bend in the region of the fourth to the sixth myotome, that is, in the cervical region. In the early human embryos so familiar from His' illustrations which show a similar sharp bend and have by some been considered as distorted, the bend occurs in the region of the 12th to the 14th myotome, that is in the dorsal region. In both these human specimens and in the mouse in which no manipulative distortion was possible, the common feature is that the bend is over the opening of the yolk-sac. Rapid growth of the myotomes together with rapid narrowing of the neck of the yolk-sac might in either case produce the condition.

The Cranial Nerves of Squalus acanthias: Oliver S. Strong, Columbia University, New York city. To be published in the *Journal of Comparative Neurology.*

The principal object of the research has been to trace the components of the V., VII., IX. and X. nerves. In doing this special attention has been paid (*a*) to the verification, by study of serial sections, of the results obtained by Stannius, Ewart and others by dissection of selachians; viz., that the canal and ampullary organs are solely innervated by certain special roots and their branches (lateral line component); (*b*) to the separation of the communis (splanchnic-sensory and end-bud) component, which has not hitherto been done in selachians.

In no case thus far in this research have any branches of the V. nerve been traced to canal or ampullary organs. These organs in the head are innervated solely by the two lateral line roots of the VII. nerve which form the rami ophthalmicus superficialis VII., buccalis VII., mandibularis externus VII. and certain minor branches. The ramus mandibularis externus VII. is apparently derived practically entirely from the more dorsal of the two lateral

line roots, the ramus buccalis receiving the major part of the remainder of this root, while the ramus ophthalmicus superficialis VII. is principally composed of the bulk of the more ventral lateral line root. This would apparently negative the view that the ampullary organs are modified end-buds and the dorsal root an end-bud root.

In accordance with the results of previous investigators, the lateral line nerve of the trunk, which shows some evidence of being really compound, is found to be derived from a special root cephalad of the IX. and X. An interesting point is that the anomalous branch of the IX. nerve to canal organs is in reality composed of fibers derived from a small separate lateral line root.

The communis root of the VII. nerve separates, distal of its ganglion, into a ramus palatinus innervating the roof of the mouth, into certain minor branches, oral and spiracular, and into the ramus mandibularis internus innervating the floor of the oral cavity. The numerous roots of the vagus are rearranged distally to the vagal ganglia into the branchial nerves, which divide into the usual pre- and post-branchial branches, the former containing communis, the latter communis and motor components, the former component innervating the lining of the pharyngeal and branchial cavities. Thus the communis component was found to conform to the general type found in other forms.

A Dissecting Pan and a Substitute for Beeswax: E. L. Mark, Harvard University, Cambridge, Mass. To be published in the *American Naturalist.*

A specimen of the dissecting pan used in the Cambridge laboratories was exhibited and its advantages over those in general use were explained. There was also described a mixture of mineral and vegetable waxes, which is better and much cheaper than the beeswax usually employed in pinning out objects to be dissected under fluids.

White Feathers: R. M. Strong, Haverford, Pa.

No white pigments have been found in feathers; the color of white feathers has been explained as due to a total reflection of the incident light from air spaces or bubbles in the feather structure.

White feathers do not differ essentially in structure from gray, brown, black, red, orange or yellow feathers, except that no pigment of any kind is present. Though some of the white comes from the walls of the air-containing medullary cells of the barb, the larger portion is produced by the barbules which have no air spaces of sufficient size to be of any significance. The white effect, as with snow or powdered glass, is dependent upon the small size of the structural elements. These have a large number of surfaces so placed for any position of the eye that the angle of incidence equals the angle of reflection with a maximum reflection to the eye. There is almost no absorption by the unpigmented feather substance, and the amount of light transmitted through the feather from objects behind is so small as to be imperceptible to the unaided eye in the intense reflection of light.

Some Remarkable Fossil Fishes from Mount Lebanon, Syria: O. P. Hay, American Museum of Natural History, New York city. To be published in *Bull. Am. Mus. Nat. History.*

This paper gives an acount of three new primitive saw-fishes and of supposed new species of eels which possess ventral fins and a palatopterygoid arch.

The Bones of the Shoulder Girdle of Fishes: Theo. Gill, Washington, D. C.

The most characteristic system of bones of the pisciform vertebrates is manifest in the shoulder girdle, and the classes of selachians and typical fishes, or teleostomes, have been segregated under the name *Lyrifera,* on account of the character of this girdle. The main elements have the form of the ancient lyre and are connected by an inferior symphysis. In the selachians the lyriform pieces are simple cartilages with which the basal elements of the pectoral fins articulate. In the teleostomes dermal bones are added to the cartilaginous pieces. The cartilaginous pieces remain such in the dipnoans, crossopterygians and ganoids. In the ganoids and especially the sturgeons, an arch is developed. In the teleosts ossification supervenes and a disintegration of the structure results in three independent bones on each side. These bones have been variously named, and by the old anatomists were considered to be homologues of the arm and forearm—humerus, radius and ulna. The view of Gegenbauer, that the principal ones represented the scapula and coracoid, has been accepted by all recent ichthyotomists except in America. The consideration of the history of the nomenclature of osteology and the development of the bones, however, militate decidedly against the acceptance of such a view. Scapula and coracoid were given originally to the composite bone and its process familiar from manifestation in man and all eutherian mammals. The bones of fishes to which the names have been given are certainly not homólogous, and consequently the application of the names is very misleading. These bones, in fact, are only developed as such in fishes specialized as teleosts and very remote from the primitive stock of the terrestrial vertebrates. A special nomenclature is therefore necessary for the bones of fishes. The so-called scapula has been designated as *hypercoracoid,* the coracoid as *hypocoracoid* and the Spangenstück or precoracoid as *mesocoracoid.* The mesocoracoid disappears in most fishes, all the acanthopterygians and offshoots from that stock being deprived of that ossicle. The modifications of the shoulder girdle and its several constituents afford excellent characters for taxonomy.

The Systematic Relations of the Fish Genus Lampris: Theo. Gill, Washington, D. C.

Very recently the foremost ichthyologist of Europe, Dr. Boulenger, has reexamined the osteology of *Lampris,* and especially the shoulder girdle, and has attained novel conceptions as to the affinities of that genus. The number of bones in the shoulder girdle of *Lampris* is the same as in ordinary acanthopterygian fishes, but two of them have been interpreted from a different standpoint than by his predecessors: (1) The very large bone which occupies the lower and posterior part of the girdle was considered by him to be a peculiar bone, named interclavicle, and homologized with a homonymous bone of the hemibranchs, and (2) the smaller one immediately above it and behind the bones supporting the pectoral fin was regarded as a 'coracoid' or hypocoracoid. Therefore Boulenger removed the genus from all connection with the scombroideans, near which it had always been assigned by previous ichthyologists, and found for it a place near the hemibranchs. In short, he considered *Lampris* as the representative not only of a peculiar family (Lamprididæ) but of an independent higher group named Selenichthyes and coordinated with the Hemibranchii and Lophobranchii; the three being associated together as representatives of a suborder to which the new name Catosteomi was given.

The conclusions thus enunciated are so startling and the authority so great that

the skeleton of *Lampris* was submitted to renewed examination. That examination forced the speaker to acceptance of the ideas of the older ichthyologists, rather than those of Boulenger; the four actinosts, or pterygials, of acanthopterygian fishes are recognized, and the coracoid of Boulenger is identified with the fourth actinost. The hypocoracoid is found in the great posterior bone called interclavicle by Boulenger. Thus the normal structure of an acanthopterygian fish is recognized. As a consequence, the genus is restored to the group of acanthopterygians. The forms and proportions of the principal bones of the shoulder girdle are nearly paralleled by undisputed acanthopterygians and relatives of the scombroideans—the Caproidæ or Antigoniidæ. Nevertheless, the differences between *Lampris* and all other fishes, as Boulenger has shown, are sufficiently great to entitle it to rank as the type of not only a distinct family (Lamprididæ), but a special superfamily (Lampridoidea).

C. JUDSON HERRICK,
Secretary.

SECTION G, BOTANY.

THE meetings of Section G of the American Association were held in Lecture Hall No. 1, on the first floor of the Columbian University Medical School. Sessions were held Tuesday morning, Tuesday afternoon and Wednesday morning, December 30 and 31, 1902.

The abstracts of papers presented are as follows:

Range of Variation in Eutypella glandulosa (Cke.) E. & E.: C. L. SHEAR, Department of Agriculture, Washington, D. C.

Eutypella glandulosa is a pyrenomycete growing on dead *Ailanthus glandulosus.* Specimens recently collected at Washington illustrate well the variability which may be expected in various parts of the plant and the conditions which seem to influence it. The parts most variable are the stromata, perithecia (number and shape) and ostiola (length and character of mouth). The stroma is sometimes almost entirely wanting, at other times well developed and conspicuously pulvinate. The perithecia vary in number from one to forty, and in shape from globose to pyriform, with all sorts of irregularities caused by pressure against each other. The ostiola are sometimes scarcely discernible, while in some specimens they reach 5 mm. in length. The tips are normally quadrisulcate, but in the long examples they are frequently acute and smooth. The asci and sporidia appear most constant, showing no corresponding variation in the extreme specimens noted. The variations found seem directly connected with the supply and the manner of supply of moisture during the development of the fungus; the maximum extreme in size and number of parts occurring where the branches bearing the plants were lying in a low place, and were more or less covered with matted grass. It is very desirable to determine the parts most variable and the range of variation in order to segregate correctly the different species in this as well as in other genera of pyrenomycetes.

Antithetic versus Homologous Alternation: DOUGLAS H. CAMPBELL, Stanford University.

Bryophytes have left scanty fossil remains, hence their relation to other forms must be deduced from comparative morphology. This discussion will concern itself with a single class of pteridophytes—the ferns. Antithetic alternation assumes that the sporophyte of the ferns is an elaboration of some bryophytic sporogonium; homologous alternation assumes that bryophytes and pteridophytes are not

genetically related. The homologous theory, based upon (1) the alga-like prothallium of certain ferns, together with (2) apospory and apogamy. The objections are (1) the alga-like protonema is almost certainly of secondary origin; (2) apospory and apogamy are readily explicable in other theories. The most primitive ferns have the least alga-like gametophytes. The numerous resemblances in both gametophyte and sporophyte point to a common origin for bryophytes and pteridophytes. Gametophytes are always aquatic: sporophytes are distinctly terrestrial structures. The evolution of the sporophyte is demonstrated by a series of liverworts. The sporophyte of bryophytes culminates in *Polytrichum* and *Anthoceros*. The sporogenous function becomes subordinate and vegetative tissues become highly developed. The uniformity in spore production is one of the strongest arguments for the common origin of archegoniates. *Anthoceros* resembles most closely the hypothetical primitive pteridophyte. The sporophytes of bryophytes and pteridophytes show many points of agreement, besides being an asexual generation derived from the oospore. Those resemblances probably represent true homologies. Objections to considering apogamy as a reversion are that apogamy occurs almost always under abnormal conditions, and in highly variable and specialized forms. Lang's hypothesis of the origin of the sporophyte is not sustained by the actual behavior of the gametophyte exposed to the assumed conditions, shown in various California liverworts and ferns. Coulter's theory as to the importance of photosynthesis in determining the origin of the leafy sporophyte is not impaired by the facts. The development of special green organs is not necessarily associated with terrestrial plants. Apospory and apogamy are analogous to adventitious budding. The water supply is the prime factor in the development of the sporophyte.

Specific Differences in the Wood of Elm Trees: W. J. Beal, Agricultural College, Mich.

The wood must be examined from a number of trees of any one species and from several places in each tree. The most reliable differences may not be the same in all genera. In elms, the number of rows and the size of open ducts, the thickness of the cell walls and the proportions of the medullary rays, are all important in determining the species.

Some Undescribed Structures in Synchytrium decipiens: F. L. Stevens, West Raleigh, N. C.

Several structures of problematic function in the nucleus and cytoplasm of the *Synchytrium* cell are described and figured. They are developed in connection with nuclear division, although their entire divergence from any previously described cytological structure renders an attempt at exact interpretation hazardous. (Illustrated by a plate and lantern slide.)

On the Manipulation of Sections of Leaf Cuticle: S. M. Bain, University of Tennessee, Knoxville, Tenn.

The author outlines his experience in handling leaf sections with special object of determining thickness of cuticle. His method is to imbed in paraffin, cut with blade of microtome knife in slanting position and unroll scrolls on drop of distilled water on slide. Preparations are then set aside and water is allowed to evaporate at room temperature. The sections are thus attached by simple adhesion to the glass, the whole process being a modification of the method of Nussbaum. Where many

sections are to be made simply to study the cuticle, the best plan is to remove the epidermis from the leaf before passing into reagents. Double staining with hæmatoxylin and Sudan III. is recommended for photomicrographic purposes.

Suggestions Relative to Botanical Periodicals and Citations: W. A. KELLERMAN, Ohio State University, Columbus, Ohio.

Since botanical periodicals have become numerous, it is considered desirable and practicable that there should be greater specialization, and especially that contributors should offer their manuscripts to those substantial journals which most distinctly represent the phase of botany concerned. If authors would thus generally discriminate according to the nature of their copy, existing and more or less specialized periodicals would become more valuable to the class of readers to which each principally appeals. Opportunity would also offer for additional magazines distinctive in character and definite in scope.

Ready and accurate citation would be enhanced if publications always bore simple, short and correct titles. Proper running head-lines are indispensable. They should contain (left page) page number, name of publication and volume number (also series if any), and (right page) date, subject (or author and subject) and page number, in order just named. No number of part (if any) should appear in headline; it should only appear on cover-page.

The rules for citation adopted by the Madison Botanical Congress should be amended in several respects—the more important being that section which requires the use of the illy understood and scarcely suggestive abbreviations for the months, such as F., Ja., Ag., O., N. and D.; the well-established abbreviations are generally used and should be sanctioned by rule.

Origin of the Patagonian Flora: PROFESSOR GEO. MACLOSKIE, Princeton, N. J.

The Patagonian flora (including that of southern Chili and the islands) contains about 2,100 species and 300 good varieties of phanerogams already described, belonging to 522 genera and 110 families. The Gramineæ have 276 species with 50 varieties, and the Compositæ about 400 species. They are chiefly derived from the Andean region; fewer from Argentina; with minor but significant contributions from Australasia, New Zealand and the Antarctic islands. Papers of Gray, Hooker and others about the North American flora are here amended so as to suppose a migration southwards on the advent of cold periods, sending to Australia and southern Chili, as far as Fuegia, forms which had been previously derived from the Arctic lands; also so as to consider the flora of the Northern Hemisphere and the Oregon-Cordilleras of North America as not primitively Scandinavian, but rather from Central Asia, whence they have radiated in all directions. This explains some of the affinities between the flora of Patagonia and that of Australia, New Zealand, Japan, etc. Besides this, there are evidences of direct transfer of plants between Patagonia, New Zealand and Australasia, by either sea or currents of air; and probably there was at one time, not a land-continuum, but a chain of islands such as would result from the elevation of the Cordilleras towards the south, and consequent emergence of elevated regions in the direction of South Shetlands and of parts towards the south pole. Victoria Land, beyond the south pole, with its volcanoes, may be part of this Cordilleran extension, and other fan-like expansions are traceable.

There are so many isolated and characteristic forms in Patagonia and neighboring parts as to indicate that it is a true

botanical region, although not closely limited from the adjacent lands. In this respect it contrasts with the Arctic regions, which have few peculiar forms. We may cite among its characteristic forms species of *Hamadeyas, Chusquea, Philesia, Lapageria, Chloræa, Arjona, Iodina, Acæna, Patagonium, Schinus,* forms of *Verbena, Pernettya, Benthamiella, Acicarpha, Azorella, Nassauvia, Perezia;* also remarkable cases of discontinuity as *Drimys* and *Veronica elliptica.*

Nuclear and Cell Division in Diplophrys stercorea Cienk.: Edgar W. Olive, Harvard University, Cambridge, Mass.

Diplophrys stercorea is an organism belonging to the Labyrinthuleæ, a group on the border line between the plant and animal kingdoms. It passes through two stages in its life-cycle—a vegetative stage in which the spindle-shaped individuals live separate and distinct from one another and a resting stage in which many individuals crawl to definite centers and there heap up in stalked, orange-colored colonies, visible to the naked eye. During the active vegetative state, the naked cells creep about over a nutrient substratum, being probably propelled by the extremely delicate, fine pseudopodia which they bear at the almost opposite poles of the spindle. The individuals in this condition each contain usually one yellowish oil body, which lies in the cytoplasm close beside the nucleus and which breaks up into minute granules during active movement or during nuclear division. The nucleus, which is plainly visible in the living organism, is of simple type, consisting of a single spherical chromatin mass, or karyosome, surrounded by karyolymph, the whole enclosed within a membrane. During nuclear division, the karyosome divides by simple constriction into two equal parts. Division of the naked spindle-shaped cell results from the progressive cleavage of a fission plane, which starts at one side and travels transversely across the cell at an oblique angle. This oblique plane of fission is unusual, since longitudinal or transverse fission is the rule among unicellular forms. The oil bodies are equally represented in the two daughter cells, and in the subsequent resting condition they usually become aggregated into one refractive yellow mass.

On the Behavior of Certain Yeast Organisms in Pure and Mixed Cultures: Wm. B. Alwood, Blacksburg, Va.

This paper treats briefly of the physiological activities of yeast organisms isolated from the fruits of apple, and then sown as pure and also as mixed cultures in an apple must of known chemical composition. The results obtained are illustrated by two graphic charts.

The Desert Botanical Laboratory of the Carnegie Institution: D. T. MacDougal, New York Botanical Garden.

A notice in regard to this laboratory has already been published in Science. Dr. MacDougal stated in greater detail the purposes and scope of the laboratory. President Gilman, Professor McGee, Professor Toumey and others took part in the discussion.

The Pines of the Isle of Pines: W. W. Rowlee, Ithaca, N. Y.

A taxonomic discussion of the West Indian hard pines and a comparison of them with the species of the Gulf states.

A new species, *Pinus recurvatus,* is described and commented upon. The ecological significance of the dense summer wood of these species is ascribed to the xerophytic conditions under which the plants exist. Specimens and photographs were used to illustrate the paper.

Studies in Araceæ: DOUGLASS H. CAMPBELL, Stanford University.

The material was collected at Kew. The species especially studied were *Aglaonema commutatum* and *Spathicarpa sagittæfolia.*

Aglaonema commutatum shows extraordinary variation in the development of the embryo-sac. The ordinary angiospermous type was never found. The number of nuclei in the mature sac is probably, in most cases, eight, but may be as many as twelve. A definite egg apparatus and antipodal cells are rarely met with, and the former is rarely at the micropylar end of the sac, but usually lateral in position. Three or four nuclei are often found in process of fusion, presumably as a preliminary to the endosperm formation. The formation of the endosperm proceeds from the base of the sac; cell walls are present from the first. The tissues of the young embryo are very little differentiated; at maturity it fills the embryo-sac. *A. pictum* conforms to the ordinary angiospermous type.

Spathicarpa sagittæfolia shows no marked deviation from the angiospermous type except in the great development of the antipodal cells subsequent to fertilization. The nuclei of the antipodal cells attain enormous dimensions. The development of the endosperm is much as in *Aglaonema.* The embryo is small.

A Preliminary Synopsis of the North American Species of the Genus Mitrula: E. J. DURAND, Ithaca, N. Y.

During the last summer species of the genus *Mitrula* were unusually abundant in the vicinity of Ithaca, N. Y. Photographs and full descriptive notes were obtained of so many species (some of which were undescribed) that it seemed desirable to attempt an arrangement of the North American species. A general preliminary synopsis of these species makes up the bulk of the paper. Further study of material in the large herbaria will be necessary before the paper will be ready for publication.

On a Fungus Disease of the Mulberry Fruit: W. A. ORTON, Department of Agriculture, Washington, D. C.

This paper gives a brief description of a disease of the mulberry in the southern states caused by an undescribed fungus which fills the seed. Specimens of the infected seeds, and also slides and drawings, were exhibited.

Numerical Variation in Plants: JESSE B. NORTON, U. S. Department of Agriculture, Washington, D. C.

A review of past work in this line—Ludwig's work and his approach to a logical explanation of the Tibonacci series of 3, 5, 8, 13, etc., as based on phyllotaxy—other literature—place and time, modes, etc.

The importance of phyllotaxy and anthotaxy in considering numerical variations, illustrated with curves constructed on the variations in numerous plants—*Sanguinaria, Chrysanthemum leucanthemum, Ranunculus,* etc.

The lack of regularity in phyllotaxy and variation of anthotaxy in individual plants and flowers as a cause of secondary modes in variation curves, illustrated by *Chrysanthemum leucanthemum,* also the relation of the whorled series 1, 2, 4, 8, 16, 3, 6, 9, 12, etc., to the alternate series 1, 3, 5, 8, 13, etc., and its multiples, as giving modes in different species not in perfect accord with the Fibonacci series.

The relation of double curves and individual plants showing tendency toward single curves in individual plants—*Chrysanthemum leucanthemum*—and changes in anthotaxy in individual heads.

The relation of reversed and normal phyllotaxy and anthotaxy to the change

in mode in curves is shown in the pineapple and chrysanthemum.

Transgressive variation due to change of anthotaxy is found in *Iris*.

Contrasts and Resemblances between the Sand Dune Floras of Cape Cod and Lake Michigan: Henry C. Cowles, Chicago, Ill.

Physically the dunes of these two regions agree: (1) In the character of the sand, except that larger grains are found at Cape Cod; (2) in the general features of dune formation and movement; and (3) in the pronouncedly xerophytic conditions for plant life. The following contrasts were observed: (1) Obscure zonation on the ocean beach (this is much less marked on the bay side of Cape Cod); (2) a vertical sea front on the dunes nearest the sea, doubtless chiefly due to sea encroachment (this feature is wanting at Nantucket); (3) the Cape Cod dunes are much lower, (4) less extensive, and (5) present a much less typical contour; (6) the dune movement is much more rapid on the Cape, as shown by self-registered measurements on half-buried trees.

Ecologically there is general similarity: (1) In the vegetation forms of the two regions; (2) in the wonderful endurance of swamp plants which are encroached upon; (3) in the general content and dynamics of the associations (but on the Cape lichen pioneer stages are often found and pines do not always precede oaks). The contrasts are: (1) The beach flora does not show clear zonation on the ocean side of the Cape, and the plants are huddled at the foot of the fore-dunes; (2) the ocean beach (but not that of the bay shore) has a much sparser plant covering than does the lake beach; (3) half-buried plants show a surprisingly vigorous leaf development on the Cape dunes; (4) the plant covering on moving dunes is more dense at Cape Cod; (5) tree shapes are less modified on the lake dunes; (6) some species mesophytic in one region are xerophytic in the other.

Floristically the two regions are astonishingly alike, the per cent. of common species being as great or greater than would be true for inland associations at such a distance.

In conclusion, the resemblances are more striking and more far-reaching than the contrasts, showing that halophytic and tidal factors are relatively unimportant in determining sand-dune or even sand-beach floras on Cape Cod. The contrasts which exist are probably due, in the main, to differences in moisture and wind relations. In most respects the Cape conditions seem to be the more severe, and yet the vegetation covering these is more dense and the growth more vigorous.

The Production of New Varieties of Oranges: Herbert J. Webber and Walter T. Swingle.

The great desideratum of the orange industry at the present time is a hardy variety that will be able to withstand the occasional severe freezes without serious injury. The deciduous trifoliate orange is perfectly hardy as far north as Philadelphia, but its fruit is small and practically worthless, though sometimes used for preserves. Several years ago the writers started experiments for the U. S. Department of Agriculture, in the production of a hardy orange by hybridizing the very hardy trifoliate orange with varieties of the ordinary sweet orange. Our aim has been to secure a new hybrid orange that would have the hardiness of the trifoliate orange and the sweet, edible fruit of the common orange. The experiments have not yet been completed, but two hybrids have been secured which possess decided

merit and will be valuable for culture north of the present orange belt.

These two hybrids have fruits about the size of a tangerine orange, varying from two to two and a half inches in diameter. The texture of the pulp is perfect in every respect, the membranes between the segments being tender and the axis very small. They are thin-skinned, very juicy and nearly seedless. Unfortunately, however, they are too sour to be eaten out of the hand without sugar. In flavor they are more like lemons or limes than oranges, but as a matter of fact they stand alone and are like no other fruit existing. They are *new creations* in the fullest sense of the term, like Burbank's plumcots. They are neither trifoliate oranges nor ordinary oranges, though in many characteristics they are strikingly intermediate between these two fruits. Neither are they lemons nor limes, though they will more nearly take the place of these fruits than oranges. The new fruits are very aromatic and have a sprightly acid flavor, with a trace of bitter, which reminds one of the lime and grape fruit. They make a superior ade which rivals lemon or lime ade. They will probably prove to be valuable also for culinary purposes to use in the place of lemons. The trees resemble the trifoliate orange mainly, though having much larger leaves, and will probably prove valuable hedge plants. They are evergreen or semi-evergreen, retaining their leaves the year round in Florida. In more northern localities they will probably lose their leaves in winter. The fruits ripen early and will be gathered before frost. Their hardiness has not yet been thoroughly tested, but young nursery trees have passed through a freeze without losing their leaves or showing any injury, while ordinary oranges beside them were defoliated and twigs the size of one's finger killed.

While the success already obtained is far-reaching, even more important results will doubtless be obtained when seeds from these fruits are grown and selections made from among the progeny, as it is well recognized that the segregation of characters ordinarily takes place in the second generation of a hybrid.

On the Production of Wart-like Intumescences produced by Various Fungicides: HERMANN VON SCHRENK, St. Louis, Mo.

Peronospora parasitica appeared in epidemic form on the cauliflower in a greenhouse of the Missouri Botanical Garden. The leaves were sprayed with various fungicides with and without the addition of glue. As a result of the spraying the lower sides of the leaves became covered with large wart-like growths after several days. These were formed by cells of the palisade parenchyma enormously elongated, giving the appearance of œdematous cells. The œdematous condition is supposed to have been caused by a stimulating action of the copper salts.

Evolution not the Origin of Species: O. F. COOK, U. S. Department of Agriculture, Washington, D. C.

Evolution, or progressive change in the characters of species, is a phenomenon quite distinct from the origination or separation of species, and due to distinct causes.

Natural selection and other aspects of environmental influence conduce to the segregation of groups of individuals which have then the opportunity to become different, but the segregation does not cause the differences, which arise through the accumulation of variations assisted by cross-fertilization.

Some Experiments in Cell and Nuclear Division: FRANK M. ANDREWS, Indiana University.

Experiment I., Influence of Hydrogen.—Young staminal hairs of *Tradescantia*

virginica were put in a three per cent. solution of cane sugar and then brought under the influence of pure hydrogen. Under such circumstances nuclei in the resting stage can not divide, but nuclei which have begun division can complete it. No cell wall is formed; when, however, oxygen is again introduced, a cell wall is formed.

Experiment II., Influence of CO_2.—Nuclear division can not take place in nearly pure CO_2, nor can nuclei which have begun to divide complete the division as stated by Demoor.

Experiment III., Influence of Ether.—No resting nucleus can divide in ether. In one per cent., three per cent., four per cent., five per cent. and six per cent. of ether, nuclei that have begun to divide can complete division and form a cell wall. In seven per cent. ether nuclear division can not take place. Nuclei in ether do not change from indirect to direct division as stated by Nathanson.

Experiment IV., Influence of Cold.—At 2° C. nuclei can divide. At —3° C. or —4° C. nuclei can not divide as stated by Demoor.

Experiment V., Influence of Chloroform.—In chloroform diluted one half with water, nuclei that have begun to divide can complete the division and a cell wall is formed.

Experiment VI., Influence of Ammonium Carbonate.—In a one fourth per cent. or one half per cent. solution of ammonium carbonate, nuclei that have begun to divide can complete division and a cell wall is formed. A one per cent. solution of ammonium carbonate kills the cell in one minute and before nuclear division can advance.

New Examples of Diurnal Nutation: F. L. Stevens, West Raleigh, N. C.

Nutation similar to that exhibited by *Helianthus* is demonstrated by lantern slides for several other genera, prominent among them being *Bidens, Amaranthus, Ambrosia, Medicago, Melilotus, Artemisia, Lespedeza, Trifolium,* etc.

Problematic Fossils, supposed to be Seaweeds, from the Hudson Group: David White, Washington, D. C.

Slabs of calcareous shale, deposited in shoal-water flats and marked with mud cracks and iron stains, bear impressions of fragments of supposed algæ of singular characters and distinctness. The fossils represent a narrow sinuous axis, now flattened, but probably nearly subcylindrical originally, alternately and repeatedly forking at an extremely wide angle at intervals of 1–2 cm., the subdivisions recurring so as to describe nearly regular and equal incomplete rings or semicircles about 3 cm. in diameter. The lobes, which end obtusely, nearly equal the axis in width, and by their ring-like form and regularity in alternate arrangement present a very striking appearance on the slab. The fossils are true intaglio impressions, or trails, destitute of carbonaceous matter. The structure of the mould bears no evidence of layers or wadding as in worm burrows. They are tentatively regarded as fucoidal and comparable to *Palæophycus* or *Buthotrephia,* though it is possible that they represent extraordinary trails made by some annelid or other animal organism. The specimens were collected by Dr. Robert Hessler in Fayette County, Indiana.

On Cultures of the Leaf-spot of the Grape, Phyllosticta Labruscæ Thm.: A. D. Selby, Wooster, Ohio.

The paper states the results of successful efforts made at the Ohio Agricultural Experiment Station, to secure the development of the various stages in the growth of this fungus on culture media. Perithecia preceded by pycnidia were obtained

repeatedly upon agar-agar made from this substance with meat extract and peptone, to which 2 per cent. of grape sugar (glucose) and .03 per cent. tartaric acid were added to approximate the proportion of these substances in ripe grapes. These perithecia contained mature asci and ascospores, and are apparently referable to the same species found heretofore in the old, rotted grape berries and referred to diverse genera—*Physalospora, Larstadia* and *Guignardia.* It seems referable to the species known as *Larstadia Bidwillii* Viala & Ravaz.

CHARLES J. CHAMBERLAIN,
Secretary.

*THE NEW YORK ZOOLOGICAL PARK AND AQUARIUM.**

THE year 1902 has been a notable one in the history of the New York Zoological Society. The municipality of New York through Park Commissioner Willcox invited the society to take over the direction of the New York Aquarium. This was a mark of strong approval by the city of the management of the Zoological Park by the society. After some deliberation the invitation was accepted, the necessary legislation at Albany was secured, and a contract was made with the municipality whereby the society should receive not less than $45,000 per annum for the maintenance of the aquarium, and should assume entire control of the personnel and the right to dismiss any of the existing employees, the contract to be terminable on six months' notice on the part either of the society or of the municipality. Mr. Charles H. Townsend, of the United States Fish Commission, was invited to become director of the aquarium. For conference and advice the society appointed a scientific committee including Professor Charles L. Bristol, of New York University, Professor Bashford Dean, of Columbia, Dr. Alfred G. Mayer, of the Brooklyn Institute of Arts and Sciences, and two other gentlemen. Fortunately, at this time Mr. Townsend was sent abroad by the United States government as expert in connection with the Seal Fisheries dispute with Russia, and this enabled the society to arrange for a complete tour of the aquaria of Europe. Mr. Townsend brought back plans, photographs and notes upon the best features of the foreign aquaria.

* From the seventh annual report.

The director, with the aid of the advisory committee, has already experimented on a number of important changes in the aquarium, including a new system of labeling and illumination of the tanks. He has also planned the introduction of a fish-hatching exhibit which will be in operation throughout the year, the arrangement for a larger variety of exhibits, especially of invertebrate forms of marine life, the closer touch with the public school system of New York by making provision for supply of material in connection with the biological courses in the schools, etc. Alterations in the aquarium, which will vastly improve the interior, are now being considered at an estimated cost of $30,000. It is probable that the necessary appropriation will be made, and that by next year the aquarium will be thoroughly well appointed. Fortunately, the design is admirable in all respects except illumination and ventilation, and both these defects can be remedied.

The attendance averages 5,000 persons a day, and the opportunities for spreading a knowledge and love of nature among the people of the city are very great.

THE ZOOLOGICAL PARK.

In the Zoological Park the attendance this year was 731,515, an increase of 38 per cent. or 200,000 over the year 1902. There were 127,000 visitors in the month

of August alone. As soon as the rapid-transit system is completed, it is anticipated that the number of visitors will double or treble.

The maintenance provided by the city for the year was $85,000, but the cost of running the park exceeded this by $3,500, paid by the society. For the year 1903, owing to the increased area occupied by the park, and the addition of several new buildings and installations, the city has provided a maintenance of $104,965. This is necessary for the care of a park one third as large as Central Park, and of collections now including 2,000 animals, of all kinds. The income from franchises and gate receipts during the year was $7,000, all of which was devoted to additions to the collections. The membership is at present 1,210; and efforts are being made to increase this to 3,000. In July, 1902, the Board of Estimate and Apportionment appropriated an additional $250,000 for the improvement and extension of the park. With these funds the system of paths has been increased by a broad walk east of the Bronx River, and another walk through the beautiful portion of the forest known as Beaver Valley, in addition to the erection of the buildings enumerated below. The society is now making application for $250,000, to be made available July 1, 1903.

The mountain sheep hill has been completed in a most admirable manner under the direction of the head forester, carrying out the general designs of Director Hornaday. The bear dens have been extended to the south, and now complete this series of installations, affording space for every species of this family which can be secured. The collection of bears is already the most complete in existence.

The chief event is the construction of the lion house, at a cost of about $150,000, from designs by Heins & La Farge, with sculpture by Mr. Eli Harvey, including finely carved sentinel lions, and two pediments, besides a variety of heads in the cornice, of the principal types of the cat family. The feature of this building is the treatment of the interior of the cages with light-green opalite tile, and a frieze of faïence tile representing desert and jungle scenes for the lions and tigers, respectively. The director was sent abroad especially to select animals for this building, with funds amounting to $13,000 donated by individual members of the board of managers. The building will be opened and completely stocked during the month of February.

The antelope house is also well under way, at a cost of $54,900. This will enable the society to add the African types of quadrupeds to its exhibits in addition to those already shown in the lion house. The bird and ostrich house has been designed for the west side of a new south court, to be named Audubon Court, bounded on the north by the reptile house, on the south by the antelope house, and on the east by the mountain sheep hill.

In addition to the sum of $25,000 subscribed chiefly for the increase of collections, the park has received some valuable gifts, including an antique Italian fountain, valued at $25,000, presented by Mr. William Rockefeller; also a memorial gateway to Joseph Lydig, former owner of the forest tract of this park.

During the coming spring the entire southern portion of Baird Court will be put in order, including the lion and the monkey houses, the large sea-lion pool, and the Rockefeller fountain. Plans are also in preparation for extending the eastern portion of the park, and perfecting the southern terminus by a plaza connected with the new rapid-transit system.

One of the most important features of

the year is the establishment of a thoroughly organized medical department under the direction of a veterinarian and a well-known human pathologist. A pathological laboratory is in charge constantly of an assistant, and daily rounds are made by an officer of the medical staff in company with the curators of the respective departments. Full reports are being kept of the symptoms of animals of various types, and of the causes of death. From these records it is proposed to prepare a special work on the habits, care and treatment of animals in captivity. The larger ruminants, especially, are susceptible to gastero-enteritis, and a disappointing feature of the work is the liability to these diseases which has been engendered on the larger ranges. Until the soil and grasses of these ranges have been thoroughly retreated, it appears that better results are secured by keeping the animals in enclosures than by allowing them free range. After a number of experiments, entirely successful methods of feeding for the prong-horned antelope and for the caribou have been discovered, and these animals are in fine condition. The western varieties of deer, the moose, the buffalo, and to a certain extent the wapiti, are still being studied.

A feature of the management of the park is the appointment of scientific curators instead of keepers in principal charge of the animals. At present the director acts also as head curator of mammals. Mr. R. L. Dittmars has recently been promoted to the full curatorship of reptiles, and assists Mr. Hornaday with the mammals. Mr. C. William Beebe has been promoted to the full curatorship of the birds. By this means a continuous series of observations of the habits of animals is being made and recorded. Mr. Beebe has been especially successful in the rearing of birds, and has made a number of valuable discoveries in the medical treatment of birds.

The chief publication of the year is by the secretary, Mr. Madison Grant, on the barren-ground and woodland caribou of the northern hemisphere.

Another function of the society has been duly followed during the year, namely, game protection. The secretary has been actively instrumental in connection with the new game laws of Alaska, Newfoundland and British Columbia, and a special fund of $3,000 has been presented to the society by Miss Stokes, of New York, the interest of which is to be devoted to the protection of birds.

The society has enjoyed the cordial cooperation of Commissioners of Parks of the Bronx and of Manhattan; also the support of Mayor Low and of Comptroller Grout. The relations with all the officers of the city have been of the most friendly character. New York now bids fair to become a model city in the management of its scientific institutions. With Professor Bumpus as Director of the American Museum of Natural History, Mr. Hornaday as Director of the New York Zoological Park, Mr. Townsend as Director of the New York Aquarium, and Dr. Mayer in charge of the zoological division of the Brooklyn Museum, the prospects for the future are extremely bright.

Henry Fairfield Osborn,
Chairman of the Executive Committee of the N. Y. Zoological Society.

SCIENTIFIC BOOKS.

Economics of Forestry. A reference book for students of political economy and professional and lay students of forestry. By Bernhard E. Fernow, director of the New York State College of Forestry. New York, Thomas Y. Crowell & Co. 1902. Pp. ix + 520. $1.50.

The appearance of this book is timely, though after many years of forestry propaganda in which its author has taken a prominent part, it may be doubted whether the average student, to say nothing of the layman, is yet fully prepared to appreciate the important principles and conclusions herein enunciated. It is written with characteristic clearness and directness by our greatest authority on the subject, and contains much of vital interest at this stage of forestry development in the United States. This review is an attempt to bring out some of its more salient features, in part in the author's own words. Limits of space unfortunately necessitate great condensation and omission of much that is well worthy of careful consideration.

In his discussion of the relation of the state to natural resources the author considers the principle, recognized in all civilized states, of the necessity of protection of the rights of the many from the unrestricted exercise of individual interests, and extends the principle to its widest interpretation by including the rights of the future many. The activity of the state has for its object the perpetuity of the well-being of society, its continued welfare and improvement; it must provide for the future, must be *providential,* hence the economy of resources, much neglected in economic literature, fully justifies the large place accorded to its discussion. "While we are debating over the best methods of disposing of our wealth, we gradually lose our very capital without even realizing the fact. Whether we have a high tariff or no tariff, an income tax or head tax, direct or indirect taxation, bimetallism or a single standard, are matters which concern, to be sure, the temporary convenience of the members of society, but this prejudicial adjustment is easily remediable. But whether fertile lands are turned into deserts, forests into waste places, brooks into torrents, rivers changed from means of power and intercourse into means of destruction and desolation—these are questions which concern the material existence itself of society; and since such changes become often irreversible, the damage irremediable, and at the same time the extent of available resources becomes smaller in proportion to population, their consideration is finally much more important than those other questions of the day."

Considering the forest as a resource, it is shown that wood supplies are, and unquestionably will continue to be, an indispensable requirement of our civilization, almost like water, air and food. In the appendix statistics are cited which show that all the industrial nations have, during the last forty to fifty years, increased their per capita consumption of wood materials greatly, in spite of the increase in the use of substitutes. The money value resulting from the mere conversion of the products of our woodlands equals at present annually a two per cent. dividend on the entire wealth of the nation, yet, owing largely to wasteful methods, hardly more than twenty to thirty per cent. of the material in the felled trees is utilized, and by the process of culling the valuable kinds the lumberman gives the advantage to the weeds in tree growth, with no reference whatever to future supplies. In Germany, on the other hand, the forest resource represents, in round numbers, a capital value of $180 per acre, paying a constant revenue of three per cent. on this capitalization, producing a constant annual gross revenue of $190,000,000, and this, too, from soils that, for the most part, would otherwise be unproductive. It is apparent that we are bound to exhaust our own stores in less time than they can be replaced, and that we are living not on interest merely, but are rapidly attacking our wood capital. Our per capita consumption is nearly nine times that of Germany, and twenty-five times that of England, a fact that suggests the possibility of a far more economical use of our timber resources.

Under the business aspects of forest production certain striking facts are presented. Thus it is stated that Saxony has taken in about $200,000,000 during the last fifty years from a small area of rough mountain land, not half a million acres, a tract half the size of many a county in the United States, and that without diminishing, but rather increasing, its earning power. In Prussia the average price of wood per cubic foot nearly doubled in the thirty-five years from 1830 to 1865, and

from 1850 to 1895 it rose nearly fifty per cent. None the less no business realizes more than the forestry business that time is money, and time is what the small capitalist does not have. Since the crop is so long making—75 to 150 years—it is a business for the state and large corporations, rather than for the individual, in most cases.

The natural history of the forest is clearly and instructively discussed in the light of certain well-known factors influencing tree growth, and emphasis is laid on the capital fact that the whole art of forestry, in its technical as well as its financial results, is based upon the knowledge and application of the laws of accretion. The growth of the individual tree, as well as the growth of the whole stand of trees, in quantity and form is subject to laws which can be formulated. The statement of these laws and their application is of much interest, but must be omitted from present consideration, as must the subject of silviculture from its professional standpoint. This latter, however, includes various important suggestions which should be heeded by the would-be reformer, among them measures for reducing the danger from fires.

The chapter on principles and methods of forest policy is one that it will well repay, not only the student, but every thoughtful citizen to read and ponder. It is shown that the forest cover bears a peculiar relation to national prosperity, and that its continuity calls for specially active interest by the community at large, and by its representative, the state. This is apparent when it is considered that the forest is a natural resource which furnishes in very large quantities materials almost as needful as food, and that it forms a soil cover which influences, both directly and at a distance, conditions of water flow, soil and local climate, thereby affecting in a most intimate way the financial, sanitary and social interests of the commonwealth. Since, then, the private capitalist is interested primarily in getting the largest present profit, the care for the future necessarily devolves on the state, and the state must interfere, wherever the interests of the future clearly demand it.

But what form shall this interference take? The answer, according to Dr. Fernow, will vary according to our conceptions of government functions, according to practical considerations of expediency, and according to the character and location of the forest areas. The exercise of *providential* functions on the part of the state is regarded as a self-evident, logical sequence of the state idea everywhere, but the manner and extent of exercising these functions must vary. In the densely populated monarchical countries of Europe, with relatively scanty resources, a much more direct and strict interference is called for than in a country which has still plenty of elbow room, with plenty of resources; here it may be expedient to leave adjustment to future consideration and action, there expediency calls for prompt and vigorous assertion of state rights and obligations.

But taking conditions and ideas as we find them, it may be accepted as a general principle that as far as forest areas serve only the one object of furnishing supplies, and form the basis of industrial activity, we may, for the present, allow our general modern policy of non-interference to prevail, based as it is on the theory, only partially true, that self-interest will secure the best use of the means of production. There is, however, one great generic difference between the forestry business and all other productive industries, which places it on a different footing as far as state interest is concerned; it is the time element which brings with it consequences not experienced in any other business. In ordinary cases the law of supply and demand coupled with self-interest can be trusted to bring about a proper balance, but in the forestry business, where the time element is so great, the balance of supply can not be maintained in this way; hence even with regard to supply forests the position of the state may properly be a different one from that which it would be proper and expedient to take toward other industrial activities.

This is much more the case when protection forests are involved. Here, in exercising a protective function, the state performs merely the primary logical duty of its existence, namely, securing for each of its members the

maximum opportunity to do for himself, preventing interference, direct or indirect, by others; it is not doing for the individual what he could have done for himself, and is not liable to the charge of paternalism.

There are three different ways in which the state can assert its authority and carry out its obligations in protecting the interests of the community at large, and of the future against the ill-advised use of property by private owners, namely, by exercising educational functions, by restrictive measures, that is police control, and lastly by direct control involving ownership and management by its own agents.

The choice of method in the United States will naturally, and rightly, be in the order named. As a general principle, only when persuasive and promotive measures fail or are insufficient, recourse is to be had to restrictive measures; only when these are inefficient or inexpedient is the state to own and manage properties.

As to educational measures, the author holds that universities have the advantage over special forestry schools and frankly expresses the view that the introduction of the subject into the primary public schools, as advocated by some propagandists, is not desirable nor expedient except incidentally. The endowment of scholarships, however, and the establishment of experimental stations are earnestly recommended, the time element involved in forestry experiments being ample justification of state aid in this direction. The dissemination of statistical information is also emphasized as a means of aiding rational legislation, and the rational conduct of private business as well. These would include estimates of the extent of absolute forest-soils and their cultural conditions, composition, age and character of timber, in short the facts which a legislature needs in order to act intelligently and the private operator must have as soon as forestry advances beyond the stage of mere lumbering.

In considering the attempts that have been made by various state governments to aid private endeavor, particularly by means of bounties, the fact becomes apparent, curiously enough, that paternal methods have found much more favor and are more extensively used in our country than in European countries, and that these methods, though seldom entirely successful, are still urgently pressed upon our legislators. The timber culture acts of 1873–1874 have proved quite ineffectual, yet as late as 1897 in Pennsylvania, and 1899 in Indiana, the same idea has been embodied in legislation designed for the encouragement of forestry, years after the crude law of the general government had been repealed because of its abuses and lack of satisfactory results. The method of encouragement recently inaugurated by the federal government, namely, to give to private owners specific advice as to the management of forest properties, has much to commend it, though it can hardly be expected that, in the absence of an obligation to follow the working plan, commensurate results will follow.

The taxation of forest property, as now conducted in most of the states, is directly and justly condemned as tending to encourage forest destruction and discourage forest management. The customary method of assessing forest property by including the value of the standing merchantable timber is compared to taxation of farm property assessed not only on the value of land, buildings and machinery, but on the value of the growing crop itself, which would be a most absurd and discouraging procedure. In Wisconsin, for example, taxes on tracts of hardwood lands, from which the pine has been removed, have averaged about ten cents per acre, that is to say, twenty to thirty per cent. of what is probably the year's production must be paid to the tax gatherer. It is safe to say that no other property is so heavily taxed. The natural result is that lumbermen propose to escape from this extortion by stripping the land as speedily as possible, and are not sanguine as to what the state is likely to accomplish in the way of a rational forest policy.

Still worse, perhaps, has been the outcome of tariff regulations, which have resulted in the more rapid cutting of our own forests and the transfer of prosperous industries from the northern states to Canada. Nevertheless, legislation in this direction is not necessarily

pernicious. In Germany there has been protective legislation since 1879, with the result of decreasing importations, but the conditions there and here, where forestry hardly exists as yet, are so different as to render comparisons of little value further than to say that the protection in Germany is given to a well-established forest-management against the competition of exploited natural woods.

The impotency of existing laws designed to prevent forest fires is recognized by every one who has given the matter attention. Under the head of principles to be kept in view when formulating legislation for protection against forest fires the following suggestions are given: (1) There is a necessity of having a well-organized machinery for the enforcement of laws, in which the state must be prominently represented; (2) responsibility for the execution of the law must be clearly defined, and must ultimately rest upon one person, an officer of the state; (3) none but paid officials can be expected to do efficient service; (4) recognition of common interest in the protection of this kind of property can come only by a reasonable distribution of financial liability for loss between the state and local community and the owners themselves.

Passing from restrictive, or police, regulations to the direct supervision and control of forest properties, it is shown that, notwithstanding the necessity of the state's assuming the function of internal improvement in cases of palpable public benefit, as, for instance, in the forcible reforestation of denuded mountain slopes, it is found that control and supervision of private property is an unsatisfactory, expensive and only partially effective method of securing conservative forest management. We are prepared, then, for the conclusion, which seems inevitable, that here, as well as in the old world, it finally becomes preferable in many cases for the community to own and manage forest areas. The ownership may rest either in the state, or in the county, town or other political subdivision which seems most interested in the maintenance of the protective cover, and possession, if it can not be had by purchase, may be obtained by the exercise of eminent domain, a right that may be reasonably exercised when public safety or public utility requires, as is incontestably the case in so many of our states at the present time. In the ideal, most highly organized state, the policy would be for the community to own or control and devote to forest crops all the poorest soils and sites, leaving only the agricultural soils and pastures to private enterprise.

From this clear and forcible presentation of the principles and methods of forest policy the author passes to a résumé of the forest policies of foreign nations, those of France, England (in India), Russia, Austria, Sweden and Norway, and Germany being specially discussed. For the education of the lower class of foresters in Germany and Austria there are some twenty special schools, while for the higher classes not only ten special forest academies are available, but three universities and two polytechnic institutes have forestry facilities. The forests of Germany cover 34,700,000 acres, or 26 per cent. of the entire land surface, a large portion of the forests covering the poorer, sandy soils of the North German plains, or the rough, hilly lands of the smaller mountain systems, and are distributed rather evenly over the entire empire. The condition of the forests depends largely on the amount of control exercised by the state authorities. It is best in all cases in the state forests, it is almost equally as good in the corporation forests under state control, and is poorest in the private forests, particularly those of small holders. In a large part of Prussia, Würtemberg, and Bavaria the corporations provide their own foresters; but these, as well as their plans of operation, must be approved by the state authorities. In Prussia and Saxony private forests are free from governmental interference, but elsewhere in the German Empire private forests are, for the most part, under some state supervision; a permit is required before land can be cleared, devastation is an offense, and in some states a badly neglected forest property may be reforested and managed by state authorities.

From this brief outline it is apparent that

forestry in its modern sense is not a new, untried experiment in Germany, but that care and active legislative consideration of forest wealth date back more than four centuries; that the accurate official records of several states for the last one hundred years prove conclusively that wherever a systematic, continuous effort has been made, as in the case of all state forests, whether of large or small territories, the enterprise has been successful; that it has proved of great advantage to the country, furnished a handsome revenue where otherwise no returns could be expected; led to the establishment of permanent wood-working industries, and has given opportunity for labor and capital to be active, not spasmodically, not speculatively, but continuously and with assurance of success. This rule has, fortunately, not a single exception. It is a highly significant fact, however, that even in Prussia, where the state is exhausting all ameliorative and persuasive means, over 75,000 acres have been deforested by private owners during the last twenty years. The state finally buys these half-wastes, restocks them at great expense, and thus public money pays for public folly in not restricting ill use of forest properties.

It is interesting to note that Japan had a forest policy earlier than any of the European nations, and has now a department of forestry controlling the management of 17,500,000 acres, or thirty per cent. of the total forest area. A forest academy has been connected with the University of Tokio since 1890.

The concluding chapters are devoted to forest conditions and the forestry movement in the United States. An area of 500,000,000 acres represents practically the forest territory of this country capable of timber production, much of it 'culled' forests from which a large part of the merchantable timber has been removed. The forest reservations of the federal government to July 1, 1902, comprise nearly 60,000,000 acres, or about one per cent. of the public domain, including brush lands, grazing lands, and desert. The state of New York owns over one and a quarter million acres and is increasing the area of the state forest, and Pennsylvania has entered upon the same policy; but in the other states forest property is still almost entirely in private hands. It is not to our credit that conservative lumbering is thus far hardly more than a name in the United States, and in most cases the policy of 'skinning,' *i. e.*, culling out the merchantable timber, prevails. It is, however, a hopeful feature of the situation that corporations and wealthy capitalists are beginning to see the financial advantages of the future in forest properties, that sporting associations are also becoming interested in forest preservation, and that the long period of agitation is finally passing into one of scientific study of our resources, with at least here and there commendable and measurably adequate legislation. It has become at last the policy of the United States government to take care of its long-neglected forest lands, but the administration of the forest reserves is still in an embryonic condition under the General Land Office, while the survey and description of forest reservations are conducted under the agency of the Geological Survey, instead of having the whole matter under the one head, namely the Forestry Bureau of the Department of Agriculture, an anomalous condition of affairs that can hardly prevail much longer.

It need hardly be said that this authoritative exposition of the economics of forestry, with the applications that have been made to present conditions and needs in the United States, can not fail to render most important service at a time when the great majority of intelligent citizens freely acknowledge the pressing necessity of a forward movement, but, in nine cases out of ten, are either hopelessly in the dark or extremely ill-advised as to the steps that ought to be taken.

V. M. SPALDING.

SOCIETIES AND ACADEMIES.

MEETING OF THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE twelfth regular meeting of the Chicago section of the American Mathematical Society was held on Friday and Saturday, January 2 and 3, at the University of Chicago. The meeting was presided over by Professor

H. B. Newson, of the University of Kansas. The following papers were read:

Dr. Saul Epsteen, University of Chicago: 'Determination of the group of rationality of a differential equation.'

Professor E. W. Davis: 'A group in logic.'

Professor H. B. Newson: 'On the generation of finite from infinitesimal transformations; a correction.'

Professor L. E. Dickson, University of Chicago: 'The ternary orthogonal group in a general field.'

Professor L. E. Dickson, University of Chicago: 'The group defined for a general field by the rotation groups.'

Professor A. S. Hathaway, Rose Polytechnic Institute: 'Vector Analysis.'

Professor James Byrnie Shaw, Kenyon College: 'On nilpotent algebras' (preliminary communication).

Professor D. F. Campbell, Armour Institute of Technology: 'On homogeneous quadratic relations in the solution of a linear differential equation of the fourth order.'

Dr. S. E. Slocum, University of Cincinnati: 'Relation between real and complex groups with respect to their structure and continuity.'

Professor Arnold Emch, University of Colorado: 'On the involution of stresses in a plane.'

Mr. R. E. Wilson, Northwestern University: 'Polar triangles of a conic and certain circumscribed quartic curves' (preliminary communication).

Professor H. S. White, Northwestern University: 'Orthogonal linear transformations and certain invariant systems of cones' (preliminary communication).

Professor R. E. Allardice, Leland Stanford University: 'On the envelopes of the axes of similar conics through three fixed points.'

The report of the committee appointed at the last Christmas meeting to devise a scheme of uniform requirements for the Master's degree for candidates making mathematics their major subject, was discussed, and portions of it adopted, the remainder being held over for consideration at the next meeting of the section. The report deals with the undergraduate program and suggests a basis for graduate study on the assumption that one year of such study will be required for the Master's degree. Copies of the report may be had from the secretary of the section.

The following officers were elected for the ensuing year:

Secretary—Professor Thomas F. Holgate.

Additional Members of the Program Committee—Professor Ernest B. Skinner and Dr. S. E. Slocum.

The next meeting of the section will be held in April.

Thomas F. Holgate,
Secretary of the Section.
Evanston, Illinois.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 136th meeting of the society, held in assembly hall of the Cosmos Club, Wednesday evening, January 14, 1903, the following program was presented:

Dr. Arthur C. Spencer exhibited some specimens of metallic copper taken from the crevices of an old wall which had been covered for perhaps thirty years by sulphide-bearing débris from the mines at Cobra, near Santiago, Cuba. A calcareous mortar was locally replaced by copper, which now occurs without admixture of any foreign material.

The chemical reactions involved were discussed by Dr. H. N. Stokes, who has recently been engaged in an extensive study of the conditions under which metallic sulphides are deposited.

In a brief review of the history of the work on ore deposits, in America particularly, Mr. S. F. Emmons introduced Mr. W. H. Weed, who proposed a genetic classification of ore deposits, whose major subdivisions are as follows:

I. Igneous (Magmatic segregations).
  A. Silicious.
  B. Basic.

II. Igneous emanation deposits (deposited by highly heated vapors and gases in large part above the critical point, *e. g.*, 365° and 200 atm. for H_2O).
  A. Contact metamorphic deposits.
  B. Veins (closely allied to magmatic veins and to division IV.).

III. Fumarolic deposits (metallic oxides, etc., in clefts in lavas; no commercial importance).

IV. Gas-aqueous (pneumato-hydato-genetic) deposits. Igneous emanations mingled with ground-waters.
  A. Filling deposits.
  B. Replacement deposits.

V. Meteoric waters.
  A. Underground.
  B. Surficial.

This classification is intended to group the geological processes forming ore deposits in such a manner as to show genetic relations, and to illustrate the subdivisions proposed by actual examples, it being understood that investigators will differ as to which class a particular deposit might be assigned.

Major subdivisions are based upon magmatic segregations at one end, and cold aqueous deposits at the other, with intermediate groups due to the emanations from igneous rock, the eruptive after-actions of Vogt, to which the term pneumatolytic has commonly been given; fumarolic when these emanations issue at low temperature and pressure; gas-aqueous in which the emanations from igneous rocks, with their burden of metals, mingle with ground-water; aqueous in which meteoric waters alone are active, both chemically and mechanically.

The igneous deposits are divided into basic and silicious, the former including the deposits of iron, copper, etc., found at igneous borders and as dikes, the latter the ore-bearing pegmatites with quartz veins as extreme examples. Under igneous emanations or pneumatolytic deposits are grouped contact metamorphic deposits shown by recent studies to be formed under conditions which preclude the presence of ordinary ground-waters or steam at a low temperature and pressure. Pneumatolytic veins, of which Cornwall tin veins are classic examples, have long been recognized as due to eruptive after-actions of this character. Geikie, Fouque and other geologists have observed the formations of metallic oxide in clefts in lavas by fumaroles, hence this division is introduced.

Under gas-aqueous the larger number of workable deposits occur, and it would be necessary to present a long list of facts assembled to show their relations and the deductions therefrom, to establish the necessity for this subdivision; but if eruptive after-effects are admitted to form contact metamorphic deposits, etc., the next group follows as a logical consequence.

Meteoric waters are admittedly the agents that have by themselves formed large and important deposits of iron and copper, but this agency is assigned to a less important place than given it by recent writers. As a whole, the classification differs very markedly from any so far proposed, being the first to recognize the facts established by Vogt, Lindgren, Kemp, Spurr and other advocates of the igneous origin of ores.

In the discussion of Mr. Weed's paper, Mr. J. E. Spurr presented to the society a genetic classification of ore deposits, upon which he has been engaged for some years. He pointed out a general similarity between this and the classification proposed by Mr. Weed, especially as regards the important place given to ore deposits formed directly by igneous processes, and the classes into which these deposits are divided, the differences between the two schemes being largely differences in relative importance of the subdivisions and in detailed grouping. Mr. Spurr expressed his full sympathy with the theories of igneous origin for ore deposits, and recalled his own advocacy of these theories as early as 1894, when, in describing the deposits of Mercur, Utah, a gaseous origin for one of the two types found there was proposed, and a deposit in limestone along a porphyry contact by waters occluded from the porphyry for the other. Again in 1896 he argued that the gold quartz veins of the Yukon district were the final silicious products of differentiation of a granitic magma.

In his continuation of the discussion Mr. Waldemar Lindgren admitted the desirability of a genetic classification and believed that the suggestions of Weed and Spurr should be followed. Deposits formed by water above the critical temperature by igneous emanations and those formed by mingling of atmospheric and igneous water are important divisions. Fumaroles and solfataras are surface phenomena and very different from deep-seated

emanations. The conception of 'mineralizing agents' was defined, and it was shown that they may be active in magma, liquids and gases as well as in the reaction of gases on solids. A better term is desirable for deposits formed above the critical temperature of water than the variously used word 'pneumatolytic.' Contact metamorphic deposits are probably directly caused by the action of igneous emanations from cooling magmas, chiefly water, on the surrounding rocks at a temperature above the critical point.

W. C. MENDENHALL,
Secretary.

CLEMSON COLLEGE SCIENCE CLUB.

THE club held its regular monthly meeting on Friday evening, January 16. The following papers were presented and discussed:

'The Salient Points in the Bacterial Analysis of Milk,' by Professor H. Metcalf. This paper described the conventional methods of milk analysis and was fully illustrated by experiments.

'Prescription Milk,' to which the first paper served as an introduction, was presented by Professor C. O. Upton. The treatment of this subject was based entirely upon the speaker's experience in the Walker-Gordon Laboratory Co., where the production of milk for clinical use is made a special work.

CHAS. E. CHAMBLISS,
Secretary.

DISCUSSION AND CORRESPONDENCE.

ORTHOPLASY, ETC.

IN SCIENCE, November 21, p. 820, Professor Conn treats 'Organic Selection' as a synonym of 'Orthoplasy,' stating that Professor Baldwin has prefered the latter term. In the work of Professor Baldwin reviewed (pp. 151, 152) we find these definitions:

"*Organic Selection:* The perpetuation and development of congenital variations in consequence of individual accommodation.

"*Orthoplasy:* The directive or determining influence of organic selection in evolution."

On p. 173 we read: 'The theory of evolution which makes general use of organic selection is called Orthoplasy.' Orthoplasy is, therefore, not identical with organic selection, but its result.

I will take this opportunity to suggest a couple of terms:

Directive Characters.—Those characters which may be useless or harmful to the individual at the time of their development, but lead to after-effects which are the cause of survival, or are at least beneficial. Example: a wandering or migratory habit might be the cause of much hardship, but in the long run might lead the individual (if he survived the early stress) to exceptionally favorable conditions. Human emigrants often illustrate this course of events.

Directive Individuals.—Those individuals which may be useless or harmful to the race during their lifetimes, but lead to after-effects which are the cause of race-survival, or are at least beneficial. Example: many reformers, such as the abolitionists, have by their actions weakened the nation to which they belonged, for the time being; but the ultimate results have been highly advantageous.

T. D. A. COCKERELL.
EAST LAS VEGAS, N. M.

SHORTER ARTICLES.

ON THE PRIMARY DIVISION OF THE REPTILIA INTO TWO SUB-CLASSES, *Synapsida* AND *Diapsida*.

SINCE 1867 there has been a slowly progressive movement toward the classification of the reptiles by the number of arches in the temporal region of the skull. The leaders have been Günther, in the separation of the Rhyncocephalia from the Lacertilia, Cope, in the union of the Archosauria and separation of the Cotylosauria, Baur, Smith Woodward and Broom in the suggested division of reptiles into two groups according to the presence of one or two temporal arches. Broom in 1901 went so far as to assign a phylogenetic value to this distinction.

Without learning until a few days ago of Broom's paper* the writer had been for some time studying the value of this idea. Classification by single characters, such as the above,

* Through a review kindly sent the writer by Franz Baron Nopsca, Jr., and received February 7, 1903.

has proved short-lived in so many cases that *a thorough comparison of all parts of the skull and skeleton* seemed absolutely necessary, and was undertaken by the writer with the valuable aid of Dr. J. Howard McGregor. It was found that the grouping suggested by the temporal arches is confirmed by a large number of characters unnoticed hitherto in this connection. On December 29, 1902, a joint-paper * was presented before the American Association in Washington in which the Reptiles were subdivided into two sub-classes as follows:

SUB-CLASS *Synapsida*.†	SUB-CLASS *Diapsida*.
I. e., Primarily with single, or united temporal arches.	*I. e.*, Primarily with double or separated temporal arches.
Cotylosauria.	*Rhyncocephalia:*
Anomodontia:	*Proganosauria.*
Dicynodontia.	*Pelycosauria.*
Cynodontia.	*Mesosauria*, etc.
Gomphodontia.	*Dinosauria.*
Theriodontia.	*Ichthyosauria.*
Placodontia.	*Phytosauria.*
Testudinata.	*Pterosauria.*
Plesiosauria.	*Squamata:*
	Mosasauria.
	Ophidia.
	Lacertilia.
	Crocodilia.
Giving rise to the Mammalia from some unknown member of the Anomodontia.	Giving rise to the Birds through some unknown type transitional between Proganosauria and Dinosauria.

In the ancestral *Synapsida:* (1) The roof of the skull is solid (Cotylosauria), or there is a single large supratemporal opening, the infratemporal opening being rudimentary or wanting; (2) the squamosal is large, coalescing with the prosquamosal and more or less covering the quadrate; (3) the quadrate is reduced and never movable; (4) the coracoid and procoracoid are separate, or united by suture; (5) the phalangeal formula is 2, 3, 3, 3, 3 or less than 2, 3, 4, 5, 3.

In the ancestral *Diapsida:* (1) The roof of the skull is open, with two temporal arches and openings; (2) the squamosal is small, frequently separate from the prosquamosal; (3) the quadrate is large, free and secondarily movable; (4) the coracoid and procoracoid are early coalesced into a single bone; (5) the phalangeal formula is 2, 3, 4, 5, 3–4.

These are the most striking of a series of characters which separate these groups. The grounds for placing the orders of Reptiles as they are in the above table will require fuller statement elsewhere.

Henry F. Osborn.

* Read before the biological section of the New York Academy of Sciences, February 9, 1903.

† The names *Protherosauria* (for *Synapsida*) and *Archosauria* (for *Diapsida*) were used in this communication. The former was abandoned because of its similarity of sound to *Proterosauria* Seeley. The latter was abandoned because Cope proposed *Archosauria* as a superorder to include only two-arched forms, whereas *Diapsida* is given *sub-class* rank and made to include the *Ichthyosauria*, *Phytosauria* and *Squamata.*

SCIENTIFIC NOTES AND NEWS.

Dr. Wilhelm Wundt, the eminent psychologist, has been elected an honorary member of the Academy of Sciences of St. Petersburg.

Plans have been inaugurated in Great Britain to secure by subscription a portrait of Lord Rayleigh. The treasurers are Sir Andrew Noble, Sir Oliver Lodge and Professor Arthur Schuster.

Dr. A. E. Ortmann, of Princeton University, has accepted the position of curator in invertebrate zoology in the Carnegie Museum, Pittsburgh.

M. Edmond Perrier has been appointed professor of comparative anatomy and M. Pierre Marcellin Boule, professor of paleontology in the Paris Museum of Natural History.

Dr. M. von Rudzki has been made director of the observatory at Cracow in place of Professor Karlinski, who has retired.

Professor Forsyth, of Cambridge University, was elected president of the Mathematical Association which held its annual meeting in London, on Saturday, January 23. The Association has 351 members.

DR. T. S. CLOUSTON has been elected president of the Royal College of Physicians, Edinburgh.

THE Royal Meteorological Society held its annual meeting on January 21, when Mr. W. H. Dines, the president, made an address entitled 'The Method of Kite-Flying from a Steam Vessel, and Meteorological Observations obtained thereby off the West Coast of Scotland.' The society now has 666 fellows. Captain D. Wilson-Barker was elected president for the ensuing year.

SIR MICHAEL FOSTER has reconsidered his intention to resign his seat as representative of London University in the House of Commons. He proposed to resign, because he did not wish to continue to vote with the unionist and conservative party, but he received assurances from graduates which lead him to retain his seat.

THE prize of $200, annually given by Dr. Frederick Peterson for the best original essay on the etiology, pathology and treatment of epilepsy, was awarded this year to Dr. Julius Donath, of Budapest, Hungary, for his paper on 'The Presence of Cholin in Epilepsy and its Significance in the Production of the Convulsive Attack.'

THE American Museum of Natural History has sent Dr. E. O. Hovey to the Lesser Antilles again to supplement the studies which he made last summer on Martinique and St. Vincent. Dr. Hovey left New York by the steamer *Caribbee,* of the Quebec line, on February 4, and will remain in the Windward and Leeward Islands two months or more. After studying the changes which have taken place on Martinique and St. Vincent as a result of the great eruptions which have occurred since last July, he will visit all the other important volcanic islands of the chain to photograph their craters, solfataras and boiling lakes, with the object of making his final report upon the eruptions of 1902 in the West Indies comprehend the entire series of Caribbean volcanoes. He will make collections of volcanic rocks and other materials for the museum.

THE Danish government is about to send a commission to the Danish West Indies to investigate their condition. Professor Ehlers, of Copenhagen, will accompany the commission to investigate the diseases prevalent on the islands.

Two members of Baron Toll's polar expedition, Lieutenant Matissen, commander of the yacht *Zaria,* and Lieutenant Kolchak, have just arrived in St. Petersburg with nine men of the *Zaria's* crew after an absence of two and a half years.

PROFESSOR HERBERT OSBORN, of the Ohio State University, gave an illustrated lecture on entomology before the Biological Club of DePauw University at Greencastle, Indiana, on the evening of January 28.

SIR WILLIAM BROADBENT will give the third Hughlings Jackson Lecture before the Neurological Society of London during the present year.

A MEETING in memory of the late John Wesley Powell will be held under the auspices of the Academy and affiliated scientific societies of Washington, at the Columbian University, on the evening of February 16, beginning at 8:15 o'clock. On this occasion the following addresses will be given:

'Powell as a Soldier,' by Hon. D. B. Henderson.

'Powell as an Explorer,' by Mr. Chas. R. Van Hise.

'Powell as a Geologist,' by Mr. G. K. Gilbert.

'Powell as an Ethnologist,' by Mr. W J McGee.

'Powell as a Man,' by Mr. S. P. Langley.

THE sum of $1500 has been collected to erect in the Hunterian Museum of the University of Glasgow a memorial of the late Professor John Young. He had been since 1866 keeper of the museum and professor of natural history and lecturer on geology in the university.

A COMMITTEE has been formed in Germany to erect a memorial at Munich to Professor Pettenkofer in recognition of his important contributions to sanitation and hygiene.

SIR GEORGE GABRIEL STOKES, the eminent mathematician, died on February 1, in his eighty-fourth year. Born in Ireland, he was educated at Cambridge, where he was senior

wrangler in 1841, and became Lucasian professor of mathematics in 1849. He was fellow of Pembroke College, was compelled to resign, by his marriage, but was reelected under the statute of 1869 and became later president of the college. He was secretary of the Royal Society from 1854–1885 and president from 1885–1890, president of the British Association in 1869, and member of parliament from Cambridge University from 1887–1892. He was made a baronet in 1889 and was a knight of the Prussian order 'pour le mérite.' Sir George Stokes' contributions to mathematics and mathematical physics have given him a foremost place among the men of science of the world.

DR. MORRILL WYMAN, one of the best known American physicians, died at Cambridge on January 29, in his ninety-first year. He had made important contributions to medical science including the recognition of the disease known as hay fever. He was a member of the board of overseers of Harvard University, and received from it the degree of LL.D. in 1886.

IT is reported in the daily papers that Mr. John D. Rockefeller will build in New York City, for the Institute for Medical Research, which he has established, a research laboratory to cost with the ground about $1,000,000. It is said that the buildings will be situated on the east side of the city in the neighborhood of Eightieth St.

THE German government has appropriated $15,000 for research for the study of the relation between tuberculosis in man and cattle.

A BILL has been introduced in the House by Mr. Slayden, of Texas, appropriating $50,000 to aid in the suppression of the bubonic plague in Mexico, and to prevent its spread in the United States. For this purpose the bill authorizes and directs the President of the United States to send a commission of three medical officers of the army and navy to investigate and report the conditions as to this disease there prevalent.

THE Pennsylvania Legislature has repealed the Fow Anti-hospital Law, and Philadelphia can now accept the Henry Phipps proposed gift of $1,000,000, and erect near the center of population an institute for the study, treatment and prevention of tuberculosis.

ROBERT E. WOODWARD, of Brooklyn, has given $25,000 to the Brooklyn Institute of Arts and Sciences, in memory of his brother, the late General John B. Woodward, and an additional $25,000 in memory of his wife.

THE *British Medical Journal* states that the sum of £10,000 has been vested in trustees by Mr. T. Sutton Timmis, for the purpose of systematic investigations into the origin and cure of cancer, which it is intended shall be carried out in the Liverpool Royal Infirmary and the new laboratories of experimental medicine in the University College, Liverpool.

AN international conference to discuss the question of erecting an international seismic observatory in Europe will be held at Berne in May. The principal European governments have agreed to send representatives.

THE Wisconsin State Board of Agriculture is considering the preservation of a group of three mounds located in State Fair Park at West Allis near Milwaukee. The Wisconsin Natural History Society is to see that these mounds are labeled. There are about one hundred large and several hundred small collections of antiquities in Wisconsin. The society is making efforts to have these placed in various libraries, museums and schools.

THE Department of Superintendence of the National Educational Association holds its meeting at Cincinnati from February 24 to 26. Among the addresses and papers are 'How to utilize fully the plant of a city school system,' President Eliot of Harvard University; 'The University of Oxford and Rhodes Scholarships,' Dr. W. T. Harris, commissioner of education; 'Some problems in manual training,' Professor C. R. Richards, Columbia University; and 'Coeducation in high schools and universities,' Professor Albion W. Small, University of Chicago. The National Society for the Scientific Study of Education, The Association of College Teachers of Education and the Educational Press Association meet at the same time and place.

On February 3, the following papers were read before the Mineralogical Society of Great Britain and Ireland, at Burlington House, London, England: 'On a meteoric stone seen to fall on August 22, 1902, at Caratash, Smyrna': by L. Fletcher, Esq., M.A., F.R.S.; 'Note on the history of the mass of meteoric iron found in the neighborhood of Caperr, Patagonia': by the same; 'On the crystalline forms of carbides and silicides of iron and manganese': by L. J. Spencer, Esq., M.A., F.G.S.; 'The refractive indices of Pyromorphite': by H. L. Bowman, Esq., M.A., F.G.S.; 'Note on quartz crystals from De Aar': by T. V. Barker, Esq. The following dates have been arranged for the meetings for 1903: February 3, March 24, June 9, November 17, anniversary.

'Why Salt Lake has fallen' is the subject of a paper by L. H. Murdoch, section director of the U. S. Weather Bureau in Salt Lake City, in the *National Geographic Magazine* for February. The rapid decline in the water level of Great Salt Lake during the past few years has caused the people of northern Utah, and more especially those of Salt Lake City, to feel considerable apprehension lest this remarkable body of water will soon be a thing of the past. The reading of the gauge at Garfield Beach on December 1, 1902, was 3 feet 5 inches below the zero of the scale, showing a fall of 11 feet 7 inches since the close of 1886, the year in which the last rise terminated. The present area of the lake is about 1,750 square miles, and its drainage basin is about twenty times that area. The writer feels confident that irrigation can not be charged with more than three or four feet of the last decline in the lake level as irrigation began in 1848, and was in operation during the years that the lake rose rapidly and maintained a high level. From 1887 to 1902 a dry cycle has prevailed, the average precipitation during this period being 14.80 inches or 1.85 inches below normal. The fall in the lake level has been much more rapid during the past three years than for any like period during the preceding years of drought. This is mainly due to the fact that the deficiency in precipitation has been greater during this period than during any similar period of the present dry cycle. The deficiency for the last three years alone was over 13 inches. The lake is not alone in showing the effects of the drought. Streams, springs and artesian wells are drying up, and those which continue active are discharging much less water than a few years ago. It seems to the writer that the large deficiency of 29.60 inches in precipitation during the past sixteen years, as shown by the Salt Lake City records, must be far more of a factor than any possible loss of water resulting from irrigating 609 square miles of land. With precipitation continuing at about 15 inches, no further fall in the lake will occur, and if the annual precipitation is as much as 15 inches for the next three years, a slight rise may be expected. A wet cycle like that which began in 1865 may begin next year, or it may not begin for fifty or more years. When it does occur the lake will respond rapidly and reach levels nearly as high as those recorded in the sixties and seventies.

The Mathematical Association (London) has received a report from its committee to consider the subject of the teaching of elementary mathematics. According to the abstract in the London *Times* the report of this committee stated, with regard to geometry: "It is desirable (1) that a first introduction to geometry should not be formal, but experimental, with use of instruments and numerical measurements, and calculations; (2) that public schools in their entrance examinations should set a fair proportion of questions requiring the use of instruments, and the obtaining of numerical results from numerical *data* by measurements from accurately drawn figures; and that in their entrance scholarship examinations the same principle should be recognized; (3) that elementary geometry papers, in examinations such as University local examinations, the examinations of the College of Preceptors, Oxford responsions, and the Cambridge previous examination, should contain some questions regarding the practical use of instruments; (4) since pupils will have been already familiarized with the prin-

cipal constructions of Euclid before they begin their study of formal geometry, it is desirable that the course of constructions should be regarded as quite distinct from the course of theorems. The two courses will probably be studied side by side, but great freedom should be allowed to the teacher as to the order in which he takes the different constructions." The report proceeded to deal with the course of constructions, the course of theorems, and the importance of riders. The committee recommended the following general order in teaching the theorems of the first three books, and thought that examiners should be requested to recognize this order:—Book I., Book III. to 32 inclusive, Book II., Book III. 35 to the end; and detailed suggestions were given. As to arithmetic and algebra, the committee considered that there was considerable danger of the true educational value of arithmetic and algebra being seriously impaired by reason of a tendency to sacrifice clear understanding to mere mechanical skill. In view of this they recommend—(*a*) that easy *viva voce* examples should be frequently used in both arithmetic and algebra; (*b*) that great stress should be laid on fundamental principles; (*c*) that, as far as possible, the rules which a pupil uses should be generalizations from his own experience; (*d*) that, whenever practicable, geometry should be employed to illustrate arithmetic and algebra, and in particular that graphs should be used extensively; (*e*) that many of the harder rules and heavier types of examples, which examinations alone compel us to retain in a school curriculum, should be postponed. With these as guiding principles the committee made various suggestions. In view of the great amount of time now required for teaching the various rules connected with our complicated system of weights and measures, the committee recorded its unanimous opinion that the interests of education demanded the early introduction of a decimal system of weights, measures and coinage.

UNIVERSITY AND EDUCATIONAL NEWS.

The Duke de Loubat has given $100,000 to Columbia University for the establishment of a chair of American archeology. Mr. M. H. Saville, curator at the American Museum of Natural History, has been elected to the professorship.

Oberlin College has received an anonymous gift of $50,000 from the same donor who recently gave $50,000.

Mr. Alexander C. Humphreys was installed as president of the Stevens Institute of Technology on February 5. Addresses were made by representatives of the trustees and faculty, by President Charles S. Thwing, of Western Reserve University, by President Henry S. Pritchett, of the Massachusetts Institute of Technology, and by Mr. Andrew Carnegie. The alumni offered a dinner and reception to President Humphreys in the evening.

An extension of the work of the College of Physicians and Surgeons, Columbia University, is about to be inaugurated by the establishment of summer courses. Practical instruction will be given in general medicine by Drs. Sumner and Draper; in neurology by Drs. Pearce Bailey and Cunningham; in gynecology by Drs. W. S. Stone and Bradley; in obstetrics by Dr. Lobenstine; in ophthalmology by Drs. Clairborne, Holden and Tyson; in laryngology by Drs. Simpson and Frothingham; in dermatology by Drs. Hodgson and Dade; in diseases of children by Drs. La Fetra and Huber; in genito-urinary diseases by the senior assistants in the department; in diseases of the stomach and intestines by Dr. Fischer; in clinical pathology by Dr. Jessup; and in physical diagnosis by Dr. Dow. Each course continues for a period of from three to five weeks, and the work will be adapted to the needs of undergraduates of the third and fourth years, and of practitioners of medicine who desire to pursue further special studies.

Dr. K. Alfred Osann, of Mülhausen, has been appointed associate professor of mineralogy at the University of Freiburg.

Sir William Turner has been appointed principal of the University of Edinburgh. He has been demonstrator of anatomy in the university since 1854 and professor since 1867.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 20, 1903.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE ST. LOUIS MEETINGS.

THOUGH nearly a year is to elapse before the American Association and affiliated bodies will meet in St. Louis, in next winter's convocation week, it is time for all who are interested not only in making this meeting a success but in welding the union of popular and technical scientific interests that was begun at the recent Washington meeting, to bestir themselves, that the good start that has already been made may not be lost.

St. Louis has long enjoyed the reputation of being a hospitable city, in which visitors are sure of good treatment, and it has the distinction of possessing one of the oldest scientific organizations of the country, in its Academy of Science, which was founded by Engelmann and his associates in 1856, struggled through the agonies of a border city in the Civil War without a cessation of its activity, and throughout has maintained the high standard with which its scientific publications were started. Its Washington University, incorporated in 1853, through the public spirit of Eliot, which has struggled against a variety of discouraging conditions without ever abating the ideals of scholarship

on which it was founded, has recently attracted attention as the recipient of numerous gifts which at length put it in position to take rank among the leading institutions of the country. Through the gift of Shaw, the city possesses, in the Missouri Botanical Garden, one of the most attractive public collections of plants in the country and a young but most hopeful center of research. The city, arranging for a great exposition, which is to open only a few months after the scientific meetings, has awakened to the need of purging itself of the attaint of bad municipal administration, which it has shared with other cities and of putting itself into twentieth century condition for its guests. There is little reason to doubt that ample and adequate provision will be made for the largest scientific gathering that can be held next winter, and if all the local educational and scientific interests are not much advanced by the inspiration that it will afford, the meeting will have failed of one of its prime objects.

The scientific interests of the country are capable of as great advancement at this meeting as at any that has yet been held. There was a time when they were all fully represented at the meetings of the American Association for the Advancement of Science, and when the persons interested but not directly engaged in scientific work were sure to see at those meetings the leaders in every field of research. That body, however, was organized quite as much for the promotion of popular interest in science as for the interchange of knowledge between those who are directly advancing the latter, and it is always irksome to listen to known facts when one would rather learn of new discoveries. With the growing complexity of science and the increase in the number of investigators having at their disposal ample facilities for the publication of their discoveries, there has developed a disposition on the part of many of the older men to stay away from the association meetings, or to attend them rather for the social and other advantages attending large gatherings than for what they could learn or impart to others in the field of their own work. This has changed, to a considerable extent, as the younger men have forged ahead in their professions so as themselves to take place as leaders, but even as this has come about there has been a marked disinclination on the part of many of these very men to present their best work to the association or to travel to any considerable distance for the interchange of ideas, when they could organize in smaller numbers near home for purposes most closely connected with their own interests and needs. Out of this grew the meetings of the American Society of Naturalists, the membership of which is based upon professional attainments rather than mere interest in science, and the bodies of kindred aims and standards that quickly affiliated with it for the holding of winter meetings, usually restricted to the vicinity of the Atlantic seaboard.

It was a most commendable purpose which caused the American Association for the Advancement of Science, with its large popular as well as professional member-

ship, to try the experiment of meeting in the winter season, in the hope that in this way the seceding professional interests might be held, while the affiliation of all the organized scientific bodies promised a power for the advancement of every interest concerned such as nothing but combination of forces could give.

In many respects, the recent Washington meeting, the first held under the new plan of the association, was the most successful and satisfactory meeting yet held in this country; but sight should not be lost of the fact that it was an experiment, not only on the part of the association, but of all the organizations that met with it, and it was scarcely to be hoped that these should not find that something in efficiency in the promotion of their individual aims had been sacrificed for the advancement of the collective interests represented. It must be conceded that the balance can not yet be struck in such a way as to show conclusively that the new plan is better than the old one. On the other hand, it is evident that such a balance should not be struck until the experiment has been carried further, and much of the conflict of interests can be avoided by the closest cooperation of the officers of the affiliated societies in the earliest stages of the preparation for the program.

It is urged on these officers, therefore, that they come together without loss of time and combine their several tasks in such a manner as to provide for a program for the St. Louis meeting which shall combine the maximum of breadth and strength with the minimum of conflict of interests. For the most efficient realization of this end, it is almost imperative that the meeting places of the different sections of the association and of the affiliated societies be closer together than proved possible in Washington, and it is to be hoped that the St. Louis committee, when organized, will spare no effort to arrange for ample meeting places for all the bodies that meet in connection with the association, as well as for its own section, in contiguity to each other, as well as conveniently situated with reference to the hotels at which most of the persons in attendance at the meeting are to stay.

That the Plant Morphologists and Physiologists and other organizations whose constitutions or precedents prescribe a limited territory within which meetings are held, may not feel warranted in setting aside these restrictions, is possible and beyond the field of extraneous criticism, although it is sincerely to be hoped that they will decide to meet within their own territory next winter only after the most careful consideration of the aid that their presence in St. Louis can afford in the effort to unify all interests. As now organized, with eastern and central branches, the American Society of Naturalists has become a truly national body, justifying its name, and will doubtless meet at St. Louis. It is to be hoped that the professional societies of national scope which have usually affiliated with it will unite with the American Association next winter, for a further trial of the plan of affiliation.

We need a national society for each of the sciences, and while these societies may

to advantage be organized in branches, an annual meeting of national character should be held. There is much to be said for holding the national meetings in convocation week and in selecting other times for the meetings of the branches and more local societies and academies. There are also good reasons for holding the meetings of all national societies at the same place. Local arrangements can be made once for all, reduced railway rates can be obtained, provision can be made for joint meetings of overlapping sciences, and men of science in different departments can make and renew acquaintance. The national societies do not relinquish in the slightest degree their individuality and autonomy by meeting with the American Association. The association has indeed proved itself ready to leave to the special societies the special programs. The American Chemical Society and the section for chemistry have for years held joint meetings without friction. When the new section of physiology and experimental medicine was organized the special programs were explicitly left to the special societies, the section proposing to confine itself to addresses and discussions which concern more than one science. At the recent Washington meeting action was taken by which all special papers in geology may be presented before the Geological Society of America. Similar plans for union have been arranged in the cases of other sciences, and a natural evolution will leave to the national societies the presentation and discussion of special research, while the sections of the association will aim to coordinate the sciences and present their advances in a form intelligible to all.

The center of scientific population and of scientific activity is no longer on the Atlantic seaboard. If we have national meetings they must sometimes be held in the central and western states. There is a general sentiment that the association and the national scientific societies might with advantage meet once in three years at Washington, once in three years in an eastern city and once in three years in a central or western city. The recent meeting at Washington was certainly successful from every point of view. It is to be hoped that all men of science will unite in making the meetings next year at St. Louis and the following year at Philadelphia equally representative of the scientific work and interests of the whole country.

THE SMITHSONIAN INSTITUTION.

The board of regents of the Smithsonian Institution held their annual meeting on January 28. The time was so fully occupied with routine business that there was no opportunity for adequate discussion of important questions concerned with the policy of the institution. An adjourned meeting was consequently called for March 11, when questions of administration will be considered. There is undoubtedly a widespread impression that the Smithsonian Institution is not accomplishing as much for the diffusion and increase of knowledge as it did in its earlier years. It is easier to criticize than to outline a constructive policy; but scientific men should certainly unite in the latter course.

The regents of the Smithsonian Institution are men of eminence, who meet once a year for an hour or two at Washington, and who can scarcely be expected to give the time or to secure the information needful for the conduct of the institution. Its organization is somewhat similar to that of our universities with one important exception—it lacks any body corresponding to the faculty. We have in most of our learned and educational institutions a board of trustees, who represent the authoritative and conservative classes. They do not give much attention to the conduct of the institution, delegating their powers largely to an executive officer. But our universities have faculties of experts, whose legal powers are unduly limited, but whose moral influence determines largely the policy and new appointments. The Smithsonian Institution and the Carnegie Institution lack such bodies of expert advisers, and if the executive officer is not in touch with the scientific men of the country, there is no way to bring the consensus of opinion before the regents or the trustees. It seems important that the board of regents should have more freqeut meetings; and that the scientific men of the country should have the opportunity of appearing before it and discussing matters with the regents and with the secretary. The difficulty seems to be that there are but few members of the board of regents who could afford the time necessary. The executive committee, however, might hold sittings for the purpose of conferring with men of science, and act as the medium by which scientific public opinion could be brought to the attention of the regents. Perhaps it would be possible for the Smithsonian Institution to appoint a visiting committee or a board of advisers who would give more attention to the detailed management of the institution than it is possible for the regents themselves to afford.

There is every reason to suppose that the regents and the secretary would be glad to learn the opinion of scientific men, and we suggest that those who have given attention to the subject should write to Secretary Langley or to the regents with whom they are personally acquainted or to whom they are known by reputation, making suggestions as to policy. The points which appear to need special attention are: (1) How the regents and secretary can be brought in contact with the scientific sentiment of the country; (2) whether it would not be advisable for the National Museum and the Bureau of American Ethnology to be given greater autonomy, and (3) if the institution is released from the conduct of government bureaus, in what directions its activities should be turned. The board of regents consists of:

Hon. M. W. Fuller, Chief Justice of the United States, Chancellor; Hon. W. P. Frye, President *pro tempore* of the United States Senate; Senator S. M. Cullom; Senator O. H. Platt; Senator Francis M. Cockerell; Representative Hugh A. Dinsmore; Representative Robert R. Hitt; Representative Robert Adams, Jr.; Dr. James B. Angell, Ann Arbor, Mich.; Dr. Andrew D. White, Ithaca, N. Y., at present abroad; Hon. J. B. Henderson, Washington, D. C.; Dr. Alexander Graham Bell, Washington, D. C.; Hon. Richard Olney, Boston, Mass.; Hon. George Gray, Wilmington, Del.; Dr. S. P. Langley, Secretary of the Smithsonian Institution.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION H, ANTHROPOLOGY.

At the recent meeting of the American Association for the Advancement of Science, held in Washington during convocation week, Section H united with the recently founded American Anthropological Association and with the American Folk-lore Society in a joint program, the papers presented being classified as far as possible by subjects, and arranged for different days. The meetings were held in the buildings of the Columbian University Law School. Section H held its special meeting on Tuesday, December 30; the American Anthropological Association on Wednesday, December 31; the American Folk-lore Society on Thursday, January 1, and on Friday, January 2, a joint session of all three societies was held. The following papers were offered for presentation to the Section (see series of titles and abstracts attached):

E. W. Tooker: 'Algonquin Names of Mountains and Hills.' (By title.)

A. L. Kroeber: 'Tribal and Social Organization of the Indians of California.' (By title.)

W. H. Holmes: 'Incrusted Crania from Caves in Calaveras County, Cal.' (Presentation.)

Franz Boas: 'Conventionalism in American Art.'

Frank Russell: 'Some Practical Problems for the Consideration of American Anthropologists.'

Military Insignia of the Omaha: Alice C. Fletcher.

Among the Omaha there were two classes of warfare, aggressive and defensive. The literal translation of the word meaning aggressive war is, in the direction of men; that of defensive war, in the direction of women or the tent. War parties ranged from eight or ten to one hundred warriors. A man seldom went to war alone, except under the stress of grief. War parties were of two classes, those organized for securing spoils and those having for their object the avenging of injuries. The latter held the higher rank. All parties were organized. The leader (the commanding officer), who must be ready to sacrifice his life for his command should circumstances demand it, and four grades of servers appointed by the leader; namely, the hunters, who must provide game; the moccasin carriers; the kettle carriers; the fire makers and water carriers. No regalia was worn in actual battle. There were six grades of war honors, each of which had its peculiar insignia. These honors could not be claimed by a man until they had been awarded through certain rites, which could only take place within the sacred tent of war. This tent and its ceremonies were in charge of the gens which camped south of the eastern opening of the tribal circle. These insignia represented a warrior's act which had been recognized by the supernatural powers and awarded in the sacred tent. Other regalia represented social relations and the interdependence of men. The eagle feather war bonnet belongs to this class. A war bonnet was not made by its wearer, but was manufactured by the warriors of the tribe with ceremony and song. A war honor had to be counted upon each of the eagle feathers, so the completed bonnet represented the warriors of the tribe who had consented to bestow this mark of distinction upon one of their fellow tribesmen.

The Extinction of the Pecos Indians: E. L. Hewitt.

The paper gave an account of the writer's attempt to find all the surviving members of the Pecos tribe. None were found remaining of the portion that settled at Santa Domingo and Zia. Of the principal remnant which settled at Jemez, only two are now living. Other descendants of Pecos Indians were found, but none of pure blood. One of the two survivors has

died since last July, and it is only through the last survivor, Augustine Pecos, that first hand information concerning the language, customs, folklore and religion of the Pecos Indians can be had. Some information gained from this old man was given.

Sheet Copper from the Mounds is not Necessarily of European Origin: Clarence B. Moore.

It was shown in the paper that, while some of the sheet copper from the mounds is of European origin, much sheet copper is purely aboriginal, as is evident by the lack of association of any objects of European make, and the fact that analyses show that the copper is in many instances hammered from pure native copper, and is far purer than any copper produced in Europe during the fifteenth, sixteenth, seventeenth or eighteenth century from the arsenical sulphide ores which have to be made use of in Europe to obtain copper, inasmuch as native copper is not present in quantities sufficient for commercial use.

The Hopewell Copper and Other Objects, are they Pre-Columbian? Warren K. Moorehead.

A summary of the evidence in favor of the pre-Columbian origin of the objects taken from the Hopewell Group, based on personal exploration of the group in question.

The Fossil Human Remains Found Near Lansing, Kansas: W. H. Holmes.

Reports of the finding of human remains deeply imbedded in loess or loess-like formations near Lansing, Kansas, came to the writer's attention early in the year 1902. In September he visited the site, accompanied by Professor T. C. Chamberlin and other geologists. Excavations were undertaken for the purpose of giving geologists an opportunity of examining the formations more critically, a month being spent in this work. The interpretation reached by those geologists who first visited the site was that the deposits enclosing the remains were of Glacial age, probably extending back to the middle of the Iowan Epoch. Later interpretations, however, favor the view that the deposits are of post-Glacial age, that they are a remnant of a fan-like delta built in and about the mouth of the little valley that opens out upon the flood-plain of the Missouri River at this point. The osteological characters and state of preservation of the human remains seem to favor the latter interpretation.

Economic Anthropology: Lindley M. Keasbey.

In the domain of physical anthropology good results have been reached. By applying the biological principles of variability and variation anthropologists have succeeded in elaborating a fairly full account of the origin, dispersion and differentiation of the human species. But in the domain of cultural anthropology confusion still prevails. This is due to the fact that no principle of continuity has been applied to the cultural activities of primitive people. The economic activities of man are necessarily antecedent to his cultural activities—true, man does not live by bread alone, but unless man labors for his daily bread he is not able to live. Therefore, anthropologists should begin their enquiries by studying the economic activities of primitive people. By applying the economic principles of utility and utilization, the anthropologist should be able to establish the first stages of industrial development and determine the essential characteristics of primitive culture.

The Excavations of the Gartner Mounds: W. C. Mills.

The mound which was located near several other famous mounds of the Ohio area,

was found to contain many burials, graves being scattered throughout the whole mound. About one third were placed below the base of the mound, at varying depths up to five feet. The base of one of the mounds was of tamped clay covering an old village site. Ashes were placed in a layer over this clay, and in this part of the mound were but few burials, and these some three and a half feet above the clay base. With many of the burials were many artifacts, and several pieces of pottery were recovered intact. With some burials, instead of pottery, the materials for making pottery were buried.

Anthropometry; its Relation to Criminology: E. LINDSEY.

The study of the outward physical characteristics of men is a branch of anthropology to which quantitative methods are applicable. The relations exhibited by these methods are the mathematical ones connecting the observations, and not the real relations of the phenomena themselves. The application of these methods in the study of criminals, united with the view of the criminal mainly as a moral offender developed by the philanthropists, gave rise to the theories of the so-called Italian school of criminology. This is susceptible of much criticism. To deduce any theory, observations on the convict class must be compared with observations on all other classes of society. Convicts must be compared with non-convicts of similar environment. Anthropometry must provide these data. While there is a correlation between psychical activity and physical structure, the physical is no measure of the psychical function, which can only be compared qualitatively. Criminology, therefore, must embrace both qualitative and quantitative studies. Criminology has no direct relation to criminal law, but should be pursued as a strictly scientific investigation, using both quantitative and qualitative methods.

The Gramophone Method in Collecting Dialects: E. W. SCRIPTURE.

The phonograph and the gramophone were compared in their usefulness in the collection of dialects, and the methods of tracing curves from the records obtained by the latter instrument demonstrated. The method of analysis of these curves was described, and plans outlined for a comprehensive collection of American dialects, constituting a phonetic and linguistic survey of the entire country, and embracing aboriginal as well as other peoples.

The Cultural Differentiation of the Maidu: ROLAND B. DIXON.

The paper called attention to the rather interesting case of the differentiation of the small Maidu stock into three more or less distinct groups, each of which was, to a considerable extent, isolated from the others. It was suggested that we might see in this differentiation in culture as well as language in this single stock, evidence of the forces which have produced the great diversity which has long been recognized to exist in California as a whole.

A Study of Spindle Whorls from Mexico to Colombia: H. NEWELL WARDLE.

This study was based on the collections of spindle whorls in the U. S. National Museum, the Academy of Natural Sciences of Philadelphia, the Free Museum of Science and Art of the University of Pennsylvania, and the American Museum of Natural History in New York. The distribution and significance of ornamental motifs were briefly considered, but the groups outlined were on the basis of technique, form and material. Eight groups were recognized for Mexico, and after reference to the spindle whorls of Chiriqui, attention was called to three strongly char-

acterized types from Colombia, hitherto undescribed.

Comparative Study of Mortuary Pottery from Pajarito Park and Tewa: E. L. HEWETT.

The paper, illustrated by many drawings, was a comparison of the designs and forms of pottery taken from the Cliff Ruins of Pajarito Park, with pottery made by the Tewa Indians of the Rio Grande Valley.

The Introduction of the Banana into Prehistoric America: O. F. COOK.

Evidence has been found which appears to establish the existence of wide distribution of the banana in pre-Spanish America. It was not, however, a native plant, and was probably introduced from the tropical Pacific islands with which, it is claimed, there are excellent indications of prehistoric communication.

Progress in Anthropology at Peabody Museum of Yale University: GEORGE GRANT MACCURDY.

The anthropological collection at Yale was begun in 1866, and might have been one of the most important of its kind in America had not Professor Marsh, who began it, turned his attention almost wholly to paleontology. His interest in anthropology continued to manifest itself in collecting only, since he had time neither to study the materials amassed nor to make a systematic exhibit of them.

The work of installation along definite lines was not begun until 1899, soon after Professor Marsh's death. During the three years ending June 30, 1902, a number of important exhibits were prepared, among them being a series representing the Paleolithic period of Europe; the Swiss Lake Dwelling collection; the Scandinavian Neolithic series; and the Egyptian, Greenland and Alaskan collections.

Since last June many valuable accessions have been received, including a beaded ceremonial shirt of buckskin from the Misses Terry, of New Haven, presented to their brother, General Alfred H. Terry, by a Sioux chief; the annual gift of Egyptian antiquities from the Egypt Exploration Fund; two Chilcat blankets and Indian and Japanese baskets from Mrs. Kate Foote Coe and her sister, Mrs. E. H. Jenkins, of New Haven; and a collection of unusual scientific value consisting of two hundred Indian baskets, and one hundred various ethnological specimens, chiefly from the Pacific coast of North America, loaned by Mr. and Mrs. William H. Moseley, of New Haven. The Moseley collection has just been installed. The curator, Mr. MacCurdy, has done some field work in three different localities of the state, which has resulted in important accessions to the museum, one of these being several hundred antiquities from a rock shelter near Pleasant Valley, the gift of Walter E. Manchester.

Origin of Surnames: ANITA NEWCOMB MCGEE.

Personal names may be grouped as class names and individual names, corresponding in present usage to forenames and surnames. Brief descriptions of forms of names among primitive and early peoples were given, with statement of the causes which led to the general use of the class designation as a surname. Greece, Rome, England, Scotland and Ireland were especially considered, and it was suggested that surnames were probably the same as, or derived from, the old clan names, brought into constant use by the demands of civilization. Anthropologists were asked to record the forms of personal names used by the primitive peoples, because they are an expression of the grade of culture which has been attained.

Recent Investigations among the Pawnee: Geo. A. Dorsey.

In speaking of his recent investigations among the Pawnee, Dr. Dorsey confined his remarks to the description of the offering to the various gods of the heart and tongue of the buffalo, this being one of the rites of an extensive ceremony in connection with a secret bundle among the Skidi band of the Pawnee, which is dedicated to the evening star, the mother of the Pawnee tribe.

One of the interesting features brought out in this presentation was that the fireplace made in the tipi during the ceremony is rectangular in shape, and not round, this being supposed to be the shape of that garden in the west presided over by the evening star, and in which the heat of the sun is periodically renewed.

Roland B. Dixon,
Secretary.

Harvard University,

THE WASHINGTON MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA, DECEMBER 30, 31, 1902, JANUARY 1 AND 2, 1903.

The society was called to order Tuesday, December 30, in a room in the building of the U. S. Geological Survey. The attendance was very large, from 75 to 100 fellows being present. An address of welcome was delivered by Director C. D. Walcott and was acknowledged by President N. H. Winchell. After routine business, memorials of Alpheus Hyatt (by W. O. Crosby), J. E. Mills (by J. C. Branner) and J. W. Powell (by W J McGee) were read. The presentation of papers was then begun, and the following were read during the meeting. Inasmuch as the society held joint sessions with Section E of the American Association for the Advancement of Science, it is impossible to give the papers in the exact order of presentation. Section E had a full program, as did also the Geological Society, and related titles were presented in succession, without regard to the body to which they had been primarily offered. In this report the printed program of the Geological Society is followed. The companion report by Dr. E. O. Hovey covered the papers primarily offered to Section E. Where an author was absent his paper is only mentioned at the close of this report, among those read by title.

The First Eparchæan Formation: H. M. Ami, Ottawa, Can.

This paper was an extension of one presented at the last winter meeting and entitled 'The Ordovician Succession in Eastern Ontario.' It emphasized the nature of the first formation which overlies the Archean crystallines in different portions of North America. Dr. Ami showed that the first Paleozoic sediments in the southern Appalachians are fragmental and of lower Cambrian age, while as we come north the strata resting on the ancient crystallines are successively later and later in age, until in Canada we find them at the top of the Ordovician. He, therefore, emphasized the probability that the earliest fossils were only to be expected in the south.

In discussion C. R. Van Hise urged the importance of care and exactness in the use of the term 'Eparchean Interval.' If used in the sense first proposed by Lawson on Lake Superior it would be a pre-Cambrian term, whereas in the paper of Dr. Ami it might as a time expression come anywhere up to the top of the Ordovician. Transgression and overlap need also to be considered. Bailey Willis remarked the distinct faunas which occurred in the same kind of rock, and emphasized the principle that lithology could not stand for time, nor has it faunal significance.

A. W. Grabau mentioned that the progressive overlap could be carried farther even up into the Silurian; and also that in New York we have in the Niagara limestone a formation whose time equivalent ought to be a sandstone in Ontario. N. H. Winchell carried the idea still farther in that in Minnesota the Cretaceous rests on the Archean, and stated that the break might be traced even to the present. Dr. Ami, in reply, stated that he used the term 'Eparchean Formation' in a purely stratigraphic sense with the purpose of emphasizing the first sandstone deposits found in various places in the East.

The Basal Conglomerate in Lehigh and Northampton Counties, Penn.: FREDERICK B. PECK, Easton, Pa.

The basal conglomerate occurs here as elsewhere, fringing the Precambrian areas. In eastern Northampton County it fails occasionally, (1) as a result of faulting or (2) because it was never deposited. It has a thickness varying from zero at Easton, to one hundred or possibly several hundred feet at Alburtis, twenty-four miles southwest of Easton.

Petrographically, it is quite variable. At times it is a coarse conglomerate, made up of quartz pebbles an inch or two in diameter. Frequently it is a medium to fine-grained arkose, consisting of about one part feldspar (orthoclase and microcline) to two or three parts quartz, the former usually thoroughly kaolinized, the latter badly crushed, and under the microscope exhibiting an undulatory extinction, and occasionally a distinctly biaxial character. Other phases of it present a dense bluish or grayish quartzite. It occasionally contains interstratified beds of a very fine-grained, argillaceous sandstone with numerous worm borings (*Scolithus*), but as yet no distinctively lower Cambrian fossils have been found. The seemingly uppermost member is a highly ferruginous, almost jaspery quartzite, which locally contains iron enough to constitute a low grade ore. From this horizon a considerable amount of iron ore was formerly derived.

In discussion Bailey Willis remarked the difficulty of tracing the break between the ancient crystallines and the lowest sediments when the latter consist of the weathered débris of the former, deposited near their source. If, however, the lowest beds are sandstones, such as now form the beaches along the Atlantic, they represent the residues, which have been repeatedly worked over by the sea, and have no necessary relations to the neighboring crystallines.

Dr. Peck replied that, in his area, they seemed to represent the products of secular decay, and to have been deposited near their source.

The Sandstones of the Ozark Region in Missouri: CURTIS F. MARBUT, Columbia, Mo.

The author first gave a short sketch of the history of geological investigation in the region, with reference chiefly to the various classifications which have been proposed for the rocks of the Ozark series. The older geologists made out four limestones and three sandstones. F. L. Nason had supported the view that there were two limestones and one sandstone. By means of maps the speaker described the evidence which had led him to the conclusion that there are certainly two, and there may be three or even four, sandstones.

Dr. Purdue remarked in discussion that there are in Arkansas at this horizon heavy sandstones and limestones, seven in number, which shade into each other.

Devonian and Carboniferous Rocks of Southwestern New York: L. C. Glenn.

The speaker discussed, with the aid of diagrams and maps, the puzzling question of the transition strata on the border between the Devonian and Carboniferous of southwestern New York and northern Pennsylvania. The strata are prevailingly shales with lenticles of conglomerate. They have received formational names, and by agreement between the paleontologists of New York and the U. S. Geological Survey the break between the periods has been placed at the base of the Wolf Creek conglomerate. In discussion J. M. Clarke described the nature of the faunal change. It is more sharply marked at the Wolf Creek conglomerate than elsewhere, although these are both antecedent Carboniferous forms and surviving Devonian ones, respectively, below and above the conglomerate.

H. S. Williams, likewise, emphasized the faunal relations, and also discussed some of the equivalencies of conglomerates in separated areas, suggested by the author. Another speaker remarked the possibility of throwing much light on the boundary between Devonian and Carboniferous by an investigation in southeastern Pennsylvania of the strata under the anthracite measures.

This paper closed the morning session. On reassembling after lunch the society divided into a petrographic section and a stratigraphic, each being held in different rooms. The stratigraphic papers follow immediately; after them the petrographic are given.

Stratigraphic Relations of the Red Beds to the Carboniferous and Permian in Northern Texas: Geo. I. Adams, Washington, D. C.

As a result of a reconnoisance in northern Texas it has been learned that the Wichita and Clear Fork divisions of the Permian, as defined by Mr. Cummins, of the Texas Survey, are in part equivalent to the Albany and Cisco divisions of what has been considered Carboniferous. The approximate limit of the red color is a line diagonal to the strike of the formations.

Comparison of Stratigraphy of the Big Horn Mountains, Black Hills and Rocky Mountain Front Range: N. H. Darton, Washington, D. C.

This communication embodied some of the results of several years' detailed study of the stratigraphy of Black Hills and Big Horn Mountain uplifts, and a series of observations extended along the front ranges of the Rocky Mountains in Wyoming and Colorado to ascertain the stratigraphic relations of the Cambrian to the Cretaceous formations in their southern extension. It has been found that the broader features are of wide distribution, but they present local variations due to differences in overlaps and dates of uplift. Some distinctive beds at several horizons have been traced continuously from far north in Dakota through Wyoming and Colorado, affording important reference planes for the correlation of the more variable or less distinctive members. The data throw much light on the history of the uplifts, especially the discovery of Laramie conglomerates containing carboniferous limestone pebbles.

The paper was illustrated by colored slides. One of the points emphasized by them was the unconformable contact between the Marine Jura and the Red beds or Permic. This unrepresented interval corresponds to the Trias.

Age of the Atlantosaurus Beds: W. T. Lee. Trinidad, Col. (Introduced by W. B. Clark.)

The paper dealt with the extension of the *Atlantosaurus* shales from their type local-

ties along the Rocky Mountain front southward into New Mexico and eastward into Oklahoma. The shales contain fossils, by which they can be correlated with the Lower Cretaceous of Texas.

A characteristic Lower Cretaceous fossil from these beds was exhibited. Professors Scott and Williston, in discussion, considered that the Lower Cretaceous age of the beds was proved by the vertebrate fossils. Both preferred the term 'Como beds' to Atlantosaurus beds. Mr. Darton had discovered similar Lower Cretaceous invertebrates in these beds.

Mr. Stanton argued that the occurrence of lithologically similar beds on the Red beds was not conclusive evidence of their stratic equivalency.

The Cretaceous-Eocene Boundary in the Atlantic Coastal Plain: W. B. CLARK, Baltimore, Md.

Some of the difficulties encountered in cartographically representing the boundary line between the Cretaceous and Eocene deposits along the Atlantic coastal border were presented. These difficulties consist, in New Jersey, in locating, on account of the continuity of deposition, a clearly defined line separating the Eocene from the Cretaceous; and in Delaware and Maryland, in determining the boundary line, because of the apparent mechanical transportation of Cretaceous fossils into the Eocene deposits where they exist side by side with Eocene forms.

The formations discussed are: (1) Potomac, possibly Upper Jurassic to Lower Cretacic, (2) Upper Cretacic, (3) Eocene, (4) Miocene and Pleocene. Marked differential movements occurred at different periods accompanied by pronounced transgressions and retrogressions. In discussion Bailey Willis made a comparison between the Atlantic and Pacific coast belts.

The Marl-loess of the Lower Wabash Valley: M. L. FULLER, Washington, D. C., and F. G. CLAPP, Boston, Mass.

A study of the marl of the lower portion of the valley of the Wabash River in southern Indiana and Illinois shows it to be the equivalent of the loess, replacing the latter over considerable areas. This marl-loess is usually a little coarser than the common loess and carries about 30 per cent. of $CaCO_3$, as compared with less than 5 per cent. in the common type. Numerous exposures have been discovered in which the materials are distinctly or even conspicuously stratified, and in some instances thin interbedded layers of fine gravel were noted. It is frequently abundantly fossiliferous, the forms being stated as a mixture of aquatic and land species. The stratified marl-loess appears to reach an altitude of about 500 feet, or some 120 feet above the flood plain of the river. Instead of forming a mantle conforming to the surface inequalities, as is the case with the common loess, the marl-loess frequently occurs as extensive flats on broad gently sloping terraces at elevations ranging from 40 to 120 feet above the river. Beneath these there is usually buried a somewhat rugged topography. In distribution, the marl-loess is confined mainly to the east side of the valley, an occurrence which is most favorable to the hypothesis of wind origin, but the balance of evidence appears to be in favor of the view, with certain limitations, of aqueous origin.

The paper was illustrated by lantern slides. Professor Chamberlin stated that the stratified deposits in question had perhaps been wrongly called loess by himself and others, as they were not like the true loess. He suggested that the term, loess-like alluvium, was more expressive of its character. The paper was also discussed by Professor Salisbury and others.

Ames Knob, North Haven, Maine; A Seaside Note: Bailey Willis, Washington, D. C.

Ames Knob is a mass of andesitic volcanic rock rising 160 feet above the sea, on the neck of land between the Fox Island thoroughfare and South Harbor, North Haven Island, in Penobscot Bay. Its petrographic character and geologic relations have been described by G. O. Smith, in his essay on the geology of the Fox Island, Maine. It is bounded on the north by a low plain cut on shales and limestones, of Niagara age, and its northern slope is a cliff resulting from the relatively great hardness of the igneous rock. The other slopes of the knob are of practically uniform rock, and variations in profile are attributable to conditions of attack, rather than of resistance. At an altitude of approximately eighty feet above the sea, on the southeastern and southern sides facing the Atlantic Ocean, is a well-marked bench from which a steep facet rises to the summit of the knob. This bench, which has an average width of about 200 yards, is attributed to the action of waves cutting at sea level. The rocks in place exposed upon this bench and about its margin exhibit rounded glaciated profiles, but no longer bear striæ, so far as observed. Hence it is inferred that the date of submergence to this level preceded or was nearly coincident with the latest episode of glaciation, and that later influences have removed the minor evidences of ice action. Upon this glaciated bench there are now deposits of glacial gravel having the characteristic forms of spits and bars, which are accordingly attributed to wave and shore currents. These deposits indicate the presence of the sea at this level after the retreat of the ice.

The simplest explanation of the facts is that Ames Knob was submerged beneath the sea to a depth of eighty feet above the present sea level during and immediately after the latest glacial episode.

Geology of Becraft Mountain, N. Y.: Amadeus W. Grabau, New York City.

Becraft Mountain in Columbia Co., N. Y., is an outlier of the Helderberg Mountains. Its base is formed by the upturned and eroded rocks of the 'Hudson' group—chiefly the Norman's Kill shales. Unconformably upon this rests the Manlius limestone (upper part), followed in turn by the members of the New York Devonian up to and including the Onondaga limestone. A detailed geological map has been prepared by the author for the New York State Survey, Department of Paleontology, and was exhibited by permission of the State Paleontologist. The structure of the eastern and southern portion of the mountain, which is of the Appalachian type, was discussed. The excessive folding and faulting of this portion of the mountain was illustrated by a map and sections.

In the petrographic section, Professor B. K. Emerson presiding, the time was largely devoted to a description and discussion of the new system of classification of the igneous rocks which has been prepared and published in a recent number of the *Journal of Geology* by Messrs. Cross, Iddings, Pirsson and Washington. By means of charts J. P. Iddings first described briefly the general principles on which the system is based and the equivalent terms under the old system. H. S. Washington then discussed the chemical aspects and the methods and reasoning by which the authors were led to their results. He showed the chemical and mineralogical confusion which exists in the old scheme and the improvements afforded by the new. Before discussion was called for, J. P. Iddings presented the following:

Chemical Composition of Igneous Rocks expressed by Means of Diagrams: JOSEPH P. IDDINGS, Chicago, Ill.

The diagrams express the molecular proportions of the chief chemical components of igneous rocks; the range of their variation; the gradations of igneous rocks chemically between extremes; the grouping of them according to the system of quantitative chemico-mineralogical classification, recently proposed by Cross, Iddings, Pirsson and Washington. The new diagram differed from the old in that, in place of the dots which were distributed in the earlier charts of the author (see *Journal of Geology,* April–May, 1898, 219), little colored geometric figures were used, drawn by the method of Brogger. Exceedingly expressive pictorial representatives of the chemistry of the eruptive rocks were thus afforded.

When discussion was called for, it was first directed against the new names suggested by the syndicate scheme of classification, and some exception was taken by G. P. Merrill to the felicity and significance of the ones selected. This was very well met by the authors, who described the process of evolution through which they had reached the ones of their choice. W. H. Hobbs critically discussed the relative numbers of analyses on which the ranges were established, urging their fewness in some cases and their abundance in others. He made the point that some indicated little more than specimen analyses. In reply, the authors showed the variety of the rocks where the analyses were few, and their abundance in the cases of the more common rocks. They also described the care with which analyses had been selected. J. F. Kemp spoke of the good results in diffusing a knowledge of the molecular proportions instead of the percentage composition which would be accomplished by the scheme. He instanced the difficulty of recasting analyses involving the alferric minerals as the stumbling-block in close work, and preferred percentage statistics of the minerals in the thin sections to the calculated 'norms.' He also felt reluctant to see texture, which is now so important, become so minor a feature. A. C. Gill spoke somewhat critically of the essential significance of 'norms' which are artificial assumptions, corresponding to no mineral in the rock. He spoke of the good results which could be gained by the use of the percentage of silica as a fundamental principle in arranging cards of analyses, subdividing them, after the choice of convenient groups, on the basis of other components.

On the whole from the discussion the more vulnerable part of the proposed scheme appeared to be the difficulty of calculating percentages from many analyses and the matter of the norms. With the many advantages of another sort and with its definiteness and logical order, all present were impressed.

The Nephelite Syenite Area of San José, Tamaulipas, Mexico: GEORGE I. FINLAY and J. F. KEMP, New York City.

The San Carlos Mountains, in the state of Tamaúlipas, Mexico, are largely made up of nephelite-syenite. This rock is exposed for ten miles along the range south of the town of San José. With it are associated dacite and andesite in the form of a laccolith, and dikes of tinguaite, analcite-tinguaite, camptonite and diabase. The general geology of the San José district was given, with a discussion of the field relations of the above rock types. They were described petrographically, and their mineralogical and chemical relations are treated in accordance with the syndicate scheme of classification outlined above.

The hour being late there was no discussion and the separate section adjourned.

On reassembling Wednesday morning the following two papers were delivered together.

Studies in the Grain of Igneous Intrusives: Alfred C. Lane, Lansing, Mich.

In studying the genesis of minerals from an igneous magma, the importance and interest of studying specimens at various known distances from the margin will be illustrated by particular instances. Slides of chips taken at known distances from the edge of flows were passed around, and even to the unaided eye the increase of coarseness toward the center was marked. The subject was then treated mathematically in connection with diagrams and with the next title:

On the Porphyritic Appearance: Alfred C. Lane, Lansing, Mich.

There are some five different kinds of phenocrysts, or crystals, which may give a porphyritic appearance, to wit:

Coarser relics of a previous consolidation.

Crystals whose formation took place during the migration of the igneous magma.

Crystals which were formed early in the process of cooling and solidification, so that their grain continues to increase clear to the center, while later formed constituents increase only for a shorter distance from it, their grain thereafter remaining uniform. This porphyritic type will be most obvious at the center of the igneous mass.

Crystals, the conditions (temperature) of whose formation were nearly half way between those obtaining initially in the igneous magma and the country rock. Such crystals will be most conspicuously porphyritic at or near the margin.

Finally there may be crystals which, like the staurolite of schists, are formed by metamorphic actions, of secondary origin, and occur in sediments, and only casually occur in igneous rocks.

Attention is particularly called to the third and fourth classes, the possibility of the existence of which has been almost overlooked, though their possible existence may be readily inferred from inspection of diagrams of the cooling of an intrusive. Certain field observations render their actual existence probable.

A Plumose Diabase containing Sideromelan and Spherulites of Calcite and Blue Quartz: B. K. Emerson, Amherst, Mass.

The paper gave a description of an extensive series of specimens of coarsely porphyritic diabase possessing feathery pyroxenes several inches long, and much very easily soluble tachylite or sideromelan, together with spherulites of calcite and this glass, or of deep cobalt-blue glass, radiating from a point near the border. The whole is thought to have been caused by the indraught of much calcareous mud, its solution in the magma and recrystallization. Many specimens were passed from hand to hand in illustration.

Shifting of Faunas as a Problem of Stratigraphic Geology: Henry S. Williams, New Haven, Conn.

A comparison of sections through the upper and middle Devonian rocks of the New York-Pennsylvania province discloses marked differences in the faunas occurring at corresponding levels. These facts were presented and their explanation found in a shifting of faunas during the time represented. The nature, extent and mode of recognition of faunal shifting in studying stratigraphy were discussed, and some conclusions, suggested by the facts, were drawn as to the desirable modification of customary practices in correlating formations by their fossils.

The sections, eight in number, extended

from Licking Co., Ohio, to Pike Co., Pa., a distance of over 500 miles. They are arranged in groups with intervals of about 100 miles. There is an almost continuous thickening to the eastward, which to the southeastward increases strongly. Three types of sediment were noted: (1) The red shale and sandstone type, especially found in the eastern end of the section. They are estuary deposits with a peculiar fish fauna. (2) The argillaceous shale type with a rich marine fauna. (3) The Black shale type with a depauperated fauna, chiefly western. The faunas shifted with the sediments.

The paper was discussed by Professor Stevenson and others.

Paleozoic Coral Reefs, with Notes on the Classification of Limestones: AMADEUS W. GRABAU, New York City.

Dome-like coral reefs have been studied by the speaker in the Paleozoic rocks of western New York, the southern peninsula of Michigan and in southeastern Wisconsin. Similar reefs have beeen described by Wyman from the Silurian of Gotland, and by Dupont from the Carboniferous of Belgium. Three types of fragmental limestones were discussed and the following terms were defined: *calcirudite, calcarenite* and *calcilutite*, corresponding to *psephite, psammite* and *pelite* among the siliceous sedimentary rocks. The desirability of such distinctive names was set forth and examples were given.

The paper was illustrated by diagrams. It was discussed by Messrs. Chamberlin, Rice, Lane, Fairchild and others. The desirability of distinctive names for the types of fragmental limestone was conceded.

Primitive Characters of the Triassic Ichthyosaurus: JOHN C. MERRIAM, Berkeley, Calif.

The paper presented a comparative study of the Triassic Ichthyosaurus with a view to determining the stage of evolution reached in these forms as compared with that seen in the Jurassic representatives of the order.

The work is based mainly on an examination of collections obtained from the upper Triassic of northern California by the University of California in the summer of 1902. In the material now available the important characters of the dentition, and of the heretofore imperfectly known paddles, can be determined with certainty.

The paper was illustrated by numerous lantern slides.

Distribution of Mastodon Remains in New York: JOHN M. CLARKE, Albany, N. Y.

Sixty mastodons have been found in New York, mostly along certain well-marked belts, viz., thirty-four in eastern New York from Albany south through Newburgh; thirteen from Rochester south through Livingston County, two near Chautauqua Lake and two near Ithaca. Outside these belts the state is barren. They, therefore, had distinct feeding grounds and that too in a not very remote time. They are now usually found resting on the boulders of old streams and in a comparatively thin layer of peat.

In discussion A. C. Lane said that in Michigan they are found down to twenty-five feet below the level of the Great Lakes. E. C. Buckley stated that in Wisconsin they occurred in the driftless area and in streams. G. F. Wright said that near Oberlin, Ohio, they are found in peat, between the second and third beaches of Lake Erie. The question was raised as to the presence of the mammoth in New York, and it was shown that no specimen had yet been discovered. When, therefore, President Roosevelt, at the time Governor of New York, urged that the mammoth should appear on its coat of arms, it was evident that although

a mighty hunter of existing big game, he was a bit weak as regards extinct types.

Permian Elements in the Dunkard Flora: DAVID WHITE, Washington, D. C.

The Dunkard series (Upper Barren Measures, XVI.) includes the topmost Paleozoic sediments in the Appalachian trough. It lies in southwestern Pennsylvania, eastern Ohio and northern West Virginia, its maximum thickness, in West Virginia, probably exceeding 1,200 feet. Its age determination rests chiefly on the land flora, the series being non-marine. The paleobotanical and lithological conclusions that the series is Permian, reached by Professors Wm. M. Fontaine and I. C. White, have been seriously questioned by some American geologists and paleontologists. Recent collecting materially increases the Permian evidence, and seems to leave little room for doubt that the beds in and above the Washington limestone are referable to the Lower Rothliegende of western Europe. The data so far obtained from the lower beds of the Dunkard are, in the judgment of the writer, not yet conclusive as to Permian age. The problem is difficult on account of the great paucity of characteristic Permian forms and the presence of a transition flora. Beds of Zechstein age seem not to have survived erosion in the Appalachian trough.

Dr. I. C. White discussed the paper and expressed his pleasure that the Whites were of the same shade of opinion for once.

Configuration of the Rock Floor of the Vicinity of New York: WILLIAM H. HOBBS, Madison, Wis.

New York city and its approaches are now the focus of engineering enterprises never before paralleled in the history of the world. The revelations afforded by these public and private undertakings are of much significance from a geological point of view, particularly, however, as regards the formation of the island and the channels surrounding it. To the data now being furnished have been added many from earlier enterprises—the numerous bridges, tunnels, well borings, foundations, etc. Many lantern slides were shown, based on the profiles of engineers and showing crushed belts and streaks of decomposed rock under the river channels and depressions. The speaker, therefore, developed an argument in favor of faults as the cause of the depressions, and as the guiding cause of the rivers in opposition to the limestone belts which have been hitherto regarded as the main directing cause.

In discussion J. F. Kemp stated the points in favor of the limestone, while admitting for certain localities the force of Dr. Hobbs's reasoning. He urged that soft and decomposed belts sometimes occurred without visible connection with faults. J. W. Spencer spoke somewhat in favor of the limestones and regarding the difficulty of demonstrating faults, as did also Bailey Willis, who, however, cited a fault which he believed to exist, bounding the southeastern edge of the ridge of Staten Island.

On the Drowned Valleys off the North Atlantic Coast: J. W. SPENCER, Washington, D. C.

This paper is a sequel to the same study presented to this society, and published in the *Bulletin* in 1894. The subcoastal plains were described. They have a breadth of from 20 to 80 miles, or 300 miles off Newfoundland, reaching to a depth of 200 to 250 feet, with, in places, an outer terrace 200 feet lower. Across this Lindenkohl traced the Hudson valley to a cañon nearly 3,000 feet below sea-level, while the author recognizes its continuation, in the contours of the con-

tinental slope, to oceanic depths. Chesapeake and Delaware valleys are buried on the subcoastal plains, but reappear in cirques at their margin, and can be traced to 60 miles down the continental slope, where they enter a deep embayment, like the Hudson. The valleys of the Gulfs of Maine and St. Lawrence, and smaller ones, are traced across the subcoastal plains into conspicuous amphitheatres in the edge of the continental shelf, and these widen out into embayments indenting the great slope to oceanic depths. The continuation of the deep fjords of Newfoundland are obstructed, supposedly by drift, in crossing the coastal plain, but this is in agreement with the fact that the Lafayette formation is older than the great valley-making epoch, but the Columbia formation was subsequent to it.

So also the remarkable deep cirques in the far North Atlantic were described.

The author considers these features, which have their analogies on the margins of the Mexican tablelands, as having been finally fashioned by atmospheric agents, in which case they become evidence of great continental elevation about the beginning of the Pleistocene period. The paper was admirably illustrated by a series of maps.

Geology of the Leucite Hills, Wyo.: W. C. Knight, Laramie, Wyo., and J. F. Kemp, New York city.

The petrography of the Leucite Hills has already been quite fully treated, but the geological relations have been hardly touched. The latter furnish the most important part of the paper, but petrographic details are not neglected. Up to date six separate exposures have been partially described. The authors have located and mapped twenty-two. The maps thus far prepared are incomplete and inaccurate. The authors have surveyed one which expresses the true relations much more faithfully. Surface flows, dikes, volcanic necks and at least one probable intruded sheet were described. The stratigraphical relationships, the probable time of intrusion and the dissection of the mesas were treated in closing, and it was shown that the outbreaks probably occurred in the late Tertiary. In discussion G. K. Gilbert remarked the probable derivation of the sheets and dikes from a parent magma, and the illustrations which they afforded of the succession of closely related eruptions from one source. Bailey Willis likewise commented on the probability of the existence of a great laccolithic reservoir beneath the surface.

The Work of the Geological Survey of Canada in 1902: Robert Bell, Ottawa, Canada.

The paper discussed the following topics: The different classes of workers, their numbers. Field-work; the parties which were sent out, objects to be attained, means employed; regions surveyed and explored from the Yukon District to Nova Scotia; some of the results. Work relating to mines and economic geology; to chemistry, mineralogy and petrography; the publication of serial reports and special treatises, with illustrations; artists' work; labors of the staff in paleontology, zoology, economic botany, fruit growing. The extension of agriculture in the north, forestry, forest fires, preservation of timber; necessity for topographical surveying in unexplored regions; the compilation and engraving of maps, those published and those in course of preparation during the year; making of illustrative models of sections and surface relief; work in connection with the museum and library; aid given to education, distribution of reports, maps, suites of named specimens of minerals and

rocks; the collecting of fossils, rocks and minerals; the preparation of pamphlets and descriptive catalogues showing the mineral wealth of Canada; displays of economic minerals, etc., at international exhibitions; contributions to archeology and ethnology; extensive correspondence of the department, great variety of subjects treated of; information and encouragement given to prospectors and explorers; usefulness of the department as a means of introducing producers and consumers to each other, and in giving information and advice leading to the establishment of new industries.

Direction of Flow of the Ancient Beaver River Shown by Pot-holes: Richard R. Hice, Beaver, Pa. (Introduced by H. L. Fairchild.)

Evidence of the slope of abandoned fluvial plains is not always conclusive as regards the direction of flow of eroding stream. Evidence of pot-hole formation is conclusive. The abandoned fluvial plain of Beaver River near Rock Point and present stream's bed below Fallston dam in same sandstone were cited. Views were exhibited showing the difference between the up-stream side and down-stream side of pot-holes at Fallston dam, the down-stream side being eroded and rounded off, the up-stream side steep, perhaps undercut. View of pot-hole on abandoned fluvial plain near Rock Point, the steep side to the south, the rounded and eroded side to the north, thus showing that the forming stream flowed northward. Pot-holes are only found where stream is rapid, hence the ones on abandoned fluvial plain indicate that the eroding stream had considerable fall to the northward, and thus the unusual width of the 'inner' valley or gorge, north of Wampum, is partly due to the erosion of the old north-flowing stream.

The Origin of Ocean Basins on the Planetessimal Hypothesis: T. C. Chamberlin, Chicago, Ill.

The Planetessimal Hypothesis of the origin of the solar system differs fundamentally from the Laplacian and other gaseous hypotheses, and from the meteoroidal hypothesis as set forth by Lockyer and Darwin. These latter assign the extension of the parent nebula to the opposed movements, collisions and rebounds of the constituent molecules or meteoroids. The former assigns it to concurrent orbital movement. In the gaseous and meteoroidal hypotheses (as usually understood) the aggregation is the simple work of gravity following a reduction of the oscillatory and colliding action. In the planetessimal hypothesis the aggregation is dependent on orbital conjunction. In the former the aggregation is massive and relatively rapid; in the latter the aggregation is individual and relatively slow. In the gaseous hypothesis the temperatures are necessarily very high, and the planets are formed by detachments. In the meteoroidal conception of George Darwin, the conditions are practically the same, and in that of Lockyer they differ rather in degree and in detail than in essence. In the planetessimal conception the planets grew up separately by innumerable accretions of infinitesimal planetoids (planetessimals) and the external temperatures were not necessarily high, since the orbits of the planetessimals were normally direct and concurrent and the aggregation came about by overtakes in contradistinction to opposed collisions, and the frequency of these was limited by the concurrent direction of orbital movement.

The purpose of the paper is to outline the hypothetical origin of the ocean basins under the planetessimal theory, to set forth the simple self-selecting process by which they were perpetuated and deepened, and

the connection of this with the dynamics of deformation.

In discussion A. C. Lane inquired as to the cause and amount of internal heat by the planetessimal hypothesis. The speaker replied that Osmund Fisher, at his request, had calculated that there would be abundant heat developed. H. F. Reid inquired regarding the visible stratification of planetessimals in the oldest known rocks, and regarding the distribution of land and water upon whose relations the study of other planets might throw light. Professor Chamberlin replied that the configuration of Mars and the moon threw no light on that of the earth; that the oldest rocks in the Lake Superior region conformed fairly well to the hypothesis. G. P. Merrill cited the basic character of meteoric material and the difficulty, therefore, of deriving acid rocks from it. The speaker replied that the hypothesis was not meteoroidal, but nebular. That he considered meteoroidal material a negligible quantity. The acidic character of the outer crust he attributed to siliceous volcanic contributions. G. K. Gilbert cited the results of his study of the moon as showing the effects of the impact of masses falling upon it, and supporting in this way the hypothesis. G. F. Becker reviewed the history of the nebular hypothesis, and showed that, even under the new hypothesis, we must assume an original nebula. He felt, therefore, that the essentials of the old conception could not be rejected. Bailey Willis made the point regarding the volcanoes of the moon, that they are explosive and yet on a planet without an atmosphere, whereas on the earth the explosions are due to steam. Professor Chamberlin replied that even on the earth volcanic action does not depend on surface water. Its vapors come from the depths.

Block Mountains of the Basin Range Province: W. M. DAVIS, Cambridge, Mass.

Observations of several of the Basin Ranges in the summer of 1902 support the opinion of Gilbert, Russell and others that the ranges observed are carved in uplifted or tilted blocks of earth-crust that had been previously much deformed and eroded. The faulting of the crustal blocks has been continued into recent geological time. The amount of erosion during the progress of faulting has been so great that the pre-fault topography cannot be safely determined.

The speaker pointed out the fact that the river valleys incised in these blocks are deep and narrow, the narrow gorges opening out suddenly on the open plains adjacent. Evidence, additional to that cited by Gilbert, of the linear character of the bases of the ranges, and of the triangular facets terminating the ridges in front, was given,—all corroborating the opinion that the ranges under consideration were formed by block faulting.

Origin of Basin Ranges: G. K. GILBERT, Washington, D. C.

Fresh interest in the origin of the Basin Ranges having been aroused by Mr. Spurr's communication to the Albany meeting of the society, the writer spent the summer of 1901 in the study of certain ranges of western Utah. The paper discussed the origin of these as indicated by their physiography and structure, and considered the nature of the evidence bearing on such questions. Evidence of block faulting was shown to exist in the nature of extensive shear zones, triangular facets terminating the ridges in front, and in the even linear bases of the ranges. That these faults are still going on was shown by displacements in the recent alluvium. On the basis of such evidence the writer was convinced that his former position regarding the origin of these ranges was correct.

Basin-Range Structure in the Death Valley Region of Southeastern California: M. R. Campbell, Washington, D. C.

Recently attention has been called to the geologic structure of the mountain ranges of Nevada and southeastern California. An attempt has been made to show that they are generally anticlinal in structure, and that the tilted-block type which Gilbert has described, and which is generally known as basin-range structure, is of rare occurrence.

The object of the present paper is to show that, although minor folding was observed in the Death Valley region, the mountains are generally composed of huge blocks of strata that have been strongly tilted and then eroded into their present forms.

The region described is traversed by two systems of structures; one extending in a north-south direction, being the southern extension of the true basin ranges of Nevada, and the other crossing these in a northwest-southeast direction parallel with and presumably an off-shoot from the main line of the Sierra Nevada. The movements which produced these structures seem to have been preceded by an epoch of slight folding in which the Paleozoic strata were somewhat deformed. This was followed presumably in Eocene time by faulting and tilting along northwest-southeast axes which formed parallel mountains and valleys trending in the same direction as the Sierra Nevada. In the valleys so formed lakes accumulated, probably through a change in climatic conditions, and sediments having a thickness of several thousand feet were laid down. In these lake beds are the great deposits of salt, gypsum, soda and borax, which have made the region famous. Following this period of sedimentation came one of movement along north-south axes, which lifted and tilted the surface into immense mountain ranges trending parallel with the new axes. Panamint, Death and Amargosa valleys were thus formed, and Funeral and Panamint mountains were raised up between them. Lakes formed in the new valleys and received sediments similar to those of the preceding period.

The age of the second lake-forming period is vaguely referred to late Tertiary. From structural and stratigraphic evidence the beds are younger than the lake sediments of Death Valley, and they are certainly older than the gravel deposits which mark the Pleistocene period in this region; therefore, they are provisionally classed as Miocene and younger.

The three papers on the Basin Range structure were discussed together.

C. R. Van Hise raised the question as to whether or not the entire displacement represented in these uplifted or tilted blocks was brought about by a single great fault or by a series of parallel breaks, which series he had termed a distributive fault. He was of the opinion that such a distributive fault was the usual if not necessary process in the production of mountains of this type.

W. M. Davis believed that a single great break would account for the phenomena observed by him, although the possible existence of parallel faults was admitted. G. K. Gilbert pointed out that, in some of the cases cited by him, parallel faults were evident, though not apparent in all instances.

The consensus of opinion as brought out by the discussion was that the evidence in the field did not support the views advanced by Mr. Spurr.

The presidential address was delivered Tuesday evening as follows:

Was Man in America in the Glacial Period? N. H. Winchell, Minneapolis, Minn.

A very enjoyable smoker was then tend-

ered the society by the fellows of the Geological Society of Washington.

The annual banquet took place at the Hotel Raleigh on Wednesday evening. One hundred and thirty-seven covers were laid.

The following papers were either read by title or were presented while the undersigned were absent on the fourth day of the session.

On the whole the meeting of the society was most successful. The attendance was probably the largest in its history, and the warmest thanks are due the Washington members for their efforts in entertaining so large a gathering.

Structural Relations in the Piedmont Area of Northern Maryland: EDWARD B. MATHEWS, Baltimore, Md.

Recent Shoreline Changes, Nantucket: F. P. GULLIVER, Southboro, Mass.

Timber Lines: ISRAEL C. RUSSELL, Ann Arbor, Mich.

Recent Volcanic Craters in Idaho and Oregon: ISRAEL C. RUSSELL, Ann Arbor, Mich.

Lakes Malheur and Harney, Oregon: ISRAEL C. RUSSELL, Ann Arbor, Mich.

Artesian Wells Near Enterprise, Idaho: ISRAEL C. RUSSELL, Ann Arbor, Mich.

Concretions and their Geological Effects: J. E. TODD, Vermilion, S. D.

Ordovician Rocks of the Bellefontaine, Penn., Section: GEORGE L. COLLIE, New Haven, Conn.

The Cambrian and Pre-Cambrian of Hoosac Mts., Mass.: JOHN E. WOLFF, Cambridge, Mass.

The Relation Between the Keewatin and Laurentide Ice Sheets: A. H. ELFTMAN, Minneapolis, Minn.

Post Glacial Time: A. H. ELFTMAN, Minneapolis, Minn.

Glacial Boulders Along the Osage River in Missouri: C. R. BUCKLEY, S. H. BALL, A. T. SMITH, Rolla, Mo.

Glacial Drainage in Central-Western New York: H. L. FAIRCHILD, Rochester, N. Y.

J. F. KEMP,
A. W. GRABAU.

COLUMBIA UNIVERSITY.

ESTEVAN ANTONIO FUERTES.

ESTEVAN ANTONIO FUERTES died at Ithaca, N. Y., January 16, after a long illness which had, nevertheless, only recently put a period to his professional work and to his service as director of the College of Civil Engineering of Cornell University. He was still Professor of Astronomy, in charge of the A. C. Barnes Astronomical Observatory of the university, which institute he had happily lived long enough to see completely erected and equipped.

Dr. Fuertes was born in San Juan, Porto Rico, May 10, 1838, the son of Estevan Fuertes, for many years governor of the island, and his wife, Demetria Charbonnier. The family is ancient and distinguished. Its members have often been remarkable for talent and have held prominent positions under the Spanish crown for generations. He was educated in his native province (Ph.D.) and at the Rensselaer Polytechnic Institute at Troy, N. Y., graduating as civil engineer (C.E.).

Returning to his native city after leaving Troy, he became, first, Assistant Engineer of Public Works, then Director of Public Works, Western Division of Porto Rico (1861–3). In 1863 he was made assistant engineer, and later engineer, of the Croton Aqueduct Board of New York city (1863–9); from which position he retired when unable to withstand the embarrassments to which he was subjected by the corrupt elements of the then city government.

In 1870–1, he was the Chief Engineer of the U. S. Ship Canal Exploring Expedition to Tehuantepec and Nicaragua, under Admiral Shufeldt, conducting its engineering and geodetic work and writing a report of great value.

In 1871 he became a consulting engineer, and practiced his profession in and near New York until, in 1873, called to Cornell University to take direction of the department of civil engineering. In this position he spent the remainder of his professional life, and built his noblest monument in the erection of the present College of Civil Engineering and the establishment of its courses of instruction.

Commencing the work, in 1873, in two small rooms of an old wooden structure on the university campus, with an equipment which, as he reported, 'could be packed into a space of about thirty cubic feet,' under the guidance of its enthusiastic director, with the assistance of an able faculty, and with a student-body consisting of but a handful of pupils, the institution has grown until it now occupies forty-two rooms, and about two hundred and fifty students are inadequately accommodated in a large stone structure. Its faculty, exclusive of a dozen in the non-professional departments of the university and of a number of non-resident 'special lecturers,' numbers eighteen, and the resources of faculty and equipment are taxed to their utmost. The greatest of all the great enterprises recently planned and pushed to completion, under the supervision of the director of the college, is the adjunct hydraulic laboratory on the bank of Fall Creek, adjacent to the university grounds, commanding the drainage of 120 square miles of territory, equipped for measurement of every variety of hydraulic flow, and which has been employed since its construction in many researches under the direction of the college and for the state and United States Executive Departments. His last, though a lesser undertaking, the A. C. Barnes Astronomical Observatory, was also the fruition of years of thought, study and careful designing.

The life of Mr. Fuertes closed with the completion of great enterprises; but his highest satisfaction was felt in the success of the young men sent out into professional work, well equipped and well trained. His reports in recent years have reiterated the statement that the demand for these young men was exceeding the supply and his last report included the assertion that but one of the regiment of alumni was known to be out of employment—a young man just returned from abroad. The record and the retrospect were exceedingly satisfying to the organizer and upbuilder of this great work when retiring from his almost lifelong task.

While too busy to accept much outside work in his later years, one of his greatest and most useful tasks was accomplished quite recently—the project for the sanitary improvement of the city and harbor of Santos, Brazil. The plans for this work were as remarkable for their extent and completeness as was the work for its magnitude.

At the close of his course of professional study, Mr. Fuertes married Mary Stone Perry, of Troy, who survives him. He leaves five adult children, one of whom, Mr. James Hillhouse Fuertes, is already well known as a successful practitioner in engineering, and another, Mr. Louis Agassiz Fuertes, has won distinction as a follower in the steps of Audubon; all inherit something of the parents' talents.

Professor Fuertes was a man of strong individuality. Earnest and ambitious, sensitive and sympathetic, his warmth of heart and his easily touched sympathies admirably complemented his more vigorous faculties, and, in all the struggles and strifes of

professional and private life, those brought into contact with him found themselves, at the close of their however forceful relations with him, imbued with a kindly and affectionate sentiment, and often became warm and strong friends.

He was a member of many scientific, technical and professional associations, at home and abroad, and his death leaves a vacancy in many ways very difficult to fill, particularly, in the position which he for a generation held as an educator of the youth of his profession.

R. H. THURSTON.

SCIENTIFIC BOOKS.

Thermodynamics of Heat-engines. By SIDNEY A. REEVE, Professor of Steam Engineering at the Worcester Polytechnic Institute. New York and London, The Macmillan Company. 1903. 12mo. Pp. 304; figs. 58; steam tables, etc.

This little book, by the author of 'The Entropy-Temperature Analysis of Steam-Engine Efficiencies,' the first formal attempt to introduce this method of analysis to the student of the heat-engines in this country by a native writer, is particularly useful as elaborating that subject still more completely and helpfully. It, however, includes very much more than this. It is an interesting, original and instructive elementary treatise on the thermodynamics of the heat-engines, written by an author who has given, evidently, much patient and illuminating thought to the subject, and who has made himself thoroughly familiar with his work.

Every chapter gives proof of independent thought, and while, unquestionably, many of the modes of expression of fundamental ideas and facts would be differently presented and probably sometimes criticized by one trained in the forms of the great school of Clausiusian writers, every competent critic will probably admit the soundness of the philosophy and the clarity of expression which distinguish the book.

The start is excellent—a page of tabulated notation—and the reader is permitted to begin his task by a comprehension of the language in which it is to be discussed. The symbols are all English. The general principles of energetics are elaborated and illustrated and viewed from various standpoints. The space taken is comparatively large; but the result is not only an understanding of, but familiarity with, the foundations of the science. The language of the 'laws' of energetics and of thermodynamics is sometimes paraphrased in multiple and with gain of understanding if not always in precision. The much-discussed 'Second Law of Thermodynamics' takes the form: 'The entropy of the world tends to a maximum and the temperature to a minimum.' It is, however, pointed out that the law may not hold with accuracy; 'since there is as yet no evidence accumulated which reveals any fixed proportion between the several sorts of energy in the universe,' and no such law can be stated, if it confines itself to a single form of energy, such as heat.

The cycles p–v and θ–ϕ, are described, compared, their uses illustrated and, particularly, their individual characteristics and special utilities exhibited. The illustrative comparison with hydraulic energy-movements is very helpful. Of the new 'Third and Fourth Laws' of energetics and of thermodynamics, it may at least be said that the author states his points correctly. The new laws may not be accepted as formally entered on the statute-book by the scientific jury which always ultimately decides such matters.

In the study of steam- and gas-engines, the two graphical forms of illustration are employed, side by side, and very admirably, in exemplification of the principles and of the operations constituting the thermodynamic case. The reader of the work can hardly fail, if intelligent and thoughtful and a conscientious student, to secure a good idea of the most abstruse points of the subject and ability to make useful applications of the knowledge thus acquired.

The book is a valuable contribution to the literature of applied thermodynamics. The appended steam table is a distinctly important

accession to our data as well as to our outfit of useful tools for work of this kind.

R. H. Thurston.

The Story of Alchemy and the Beginnings of Chemistry. By M. M. Pattison Muir. New York, D. Appleton & Co. 1903. 12mo. Pp. 182. Ill.

The author of this little book, Matthew Moncrieff Pattison Muir, fellow and prælector in chemistry of Gonville and Caius College, Cambridge, is known to the scientific world as joint editor with Dr. Foster Morley of the new edition of Watts' 'Dictionary of Chemistry,' as the translator of Ostwald's 'Solutions,' and as author of several treatises on practical chemistry published in part with the cooperation of others. Besides these valued works he is the author of 'The Story of the Chemical Elements' (London, 1896), as well as of 'The Alchemical Essence and the Chemical Element' (London, 1894). In the latter Professor Muir showed the weakness of the pseudo-science of alchemy in the attempts of its advocates to explain natural facts by wit and reason, before they had ascertained what the facts were that required explanation, and he contrasted with this useless undertaking the well-grounded, suggestive and rational methods of modern chemistry.

In 'The Story of Alchemy' the author expands and elaborates this view of alchemy and points out that it regarded nature by emotional methods, and that they resulted in baseless speculations; the alchemist 'began the study of nature with introspection, and spins his universe from his own ideas of order, symmetry and simplicity, as the spider spins her web from her own substance.' One of the characteristic features of alchemical doctrine was a commingling of ethical and physical ideas; the alchemists attributed to natural things moral virtues and even vices, and remains of this survive in many expressions still in use, such as 'noble and base metals,' 'imperfect gases,' and 'good and bad conductors of electricity.' These are Muir's examples, but the reviewer suggests that in some of these cases the adjectives 'good and bad' signify 'successful and unsatisfactory' (or terms analogous thereto) without any idea of imputing moral qualities.

The transmutation of metals was a natural adjunct of alchemical theory, and was based in part on observation of nature's methods, but erroneously interpreted; philosophers regarded metals as living things, and since nature strove to bring other living things to a more perfect state, so too the noble metals had been evolved from the ignoble and less valuable ones by Nature herself in the bowels of the earth. Were not gold found in copper mines and silver in lead mines, proofs of this?

Conceptions of an orderly, material universe were so intimately associated with ideas of morality and with religious beliefs, that to disprove the possibility of the great transmutation would have undermined the basis of material things as well as of ethics. Plants are improved by appropriate culture, by loosening and enriching the soil, and by choice of seed; animals are improved by judicious breeding; metals by analogous processes should be helped toward perfection. Metals, the alchemists argued, have bodies, souls and spirits; each has specific bodily form, a metalline soul characteristic of a class, and a spirit, or inner immaterial potency, the very essence of all metals. They asserted that there is present in all things One Thing, the Primal Element, and the final aim of alchemy was to obtain this primal element, the soul of all things, so purified from all admixture of 'elements' and 'principles' as to make it available for any transmutation. To secure this essence required patient, prolonged study in the laboratory, and the quest was fraught with peril.

After stating that the words 'element' and 'transmutation' did not mean to the alchemist what they signify at the present time, the author remarks that our present knowledge makes such a change as lead into silver unthinkable, yet facts *may* be discovered which will make possible the separation from lead of things unlike itself, from which silver may be produced by the combination of some of these constituents.

The alchemical quest of the primal matter still goes on, but modern chemistry conducts it in a more rational manner; considerations

of the atomic weights of the elements, their grouping and classification, suggest that elements merely mark stable points in a process of change; but the investigations are still in a nebulous condition. The phenomena of Röntgen rays and Becquerel rays enter into this conception. After all, the modern chemical problem bears only a superficial resemblance to the alchemical quest for the 'One Thing.'

'The Story of Alchemy' is not a history of the pseudo-science, but rather a philosophical examination of its true significance and aims, told in an attractive, interesting manner by a competent scholar. The title of the book, which is necessary as one of a series, is misleading; the work makes no attempt to depict the sociological influence of alchemy by detailing its fortunes and misfortunes, but this does not detract from its value to students and the general reader.

It is interesting to note that 'sulfur' is spelled throughout in the manner recommended by the American Association for the Advancement of Science in 1891.

Henry Carrington Bolton.

SCIENTIFIC JOURNALS AND ARTICLES.

The *Botanical Gazette* for January contains the twenty-fourth installment of 'Undescribed Plants from Guatemala and other Central American Republics,' by John Donnell Smith, Thirteen new species are described by the author and the specialists to whom particular groups have been referred. *Zamia Tuerckheimii* is illustrated upon a double lithograph plate.—Professor J. C. Arthur, of Purdue University, reports upon the third series of 'Cultures of Uredineæ,' which were made during the season of 1902. One hundred and twenty-three collections of material were employed, and 327 cultures attempted, representing 43 species of rusts and using 102 species of hosts. In no case was success in connecting the generations of these puzzling plants attained where definite clues derived from field observation were lacking. Fourteen species tried by the guessing method were involved in these failures. Twelve that had been studied with success before were again successfully grown and the confirmatory results are recorded. Seven species of rusts were successfully cultivated and the connection between the æcidial and teleutosporic generations established. Three new names are proposed.—Arthur L. Dean, of Yale University, gives an account of his 'Experimental Studies on Inulase.' This enzyme, found in *Aspergillus* and *Penicillium*, does not diffuse into the culture medium. It acts most vigorously at a temperature of 55° C. and in a medium containing .0001 normal H_2SO_4; .01 normal destroying it.—Dr. B. E. Livingston discusses 'The Distribution of the Upland Plant Societies of Kent County, Michigan.' The climatology and geology of the county are described and the vegetation of the uplands classified into five societies, whose distribution is shown upon a map of the county. A list of the plants constituting these societies is given and the relative frequency of the different species is indicated. The writer holds that the controlling soil factor in distribution is one of drainage. While the present observations seem to justify the hypothesis that physiography determines vegetation, the writer thinks that the main question with which we have to deal lies still untouched, namely, 'What is it in the nature of the soil which determines the distribution of plant societies?' He offers the hypothesis that 'The decisive factor in plant distribution on a small upland area is in most cases the moisture-retaining property of the soil.' Of course the historic factor must also be taken into consideration.—Professor Albert Schneider, of Northwestern University, contributes a second paper on the 'Biology of *Rhizobia*' in which he corrects a previous statement that *Rhizobium mutabile* is absolutely non-motile, showing that while this is true of the species in most neutral media, espcially in solid ones, it is decidedly motile in acid media, the growths being grayish to light gray and brownish-gray in color, and the motile forms much smaller and more uniform in size than the non-motile ones.—The number closes with twenty-two pages of notices of current literature and news items.

C. R. B.

The American Naturalist for January contains an article by Hubert L. Clark, on 'The Water Snakes of Southern Michigan,' which contains a detailed study of the species found there and concludes that *Natrix erythrogaster* is a well-defined species of recent production, probably derived from some form of *N. fasciata,* but not *sipedon.* Edward W. Berry describes some 'New or Hitherto Unknown Ephemerid Nymphs of the Eastern United States,' and R. W. Shufeldt has a paper 'On the Classification of Certain Groups of Birds.' This deals with the Saururæ, the struthious birds, and the Odontoholcæ, but the writer does not seem to have consulted Pycraft's important memoir on the Palæognathæ. Charles C. Willoughby discusses 'Hats from the Nootka Sound Region,' and the number is completed by a number of important reviews.

THE *National Geographic Magazine* (Washington) for February publishes as a supplement the North Atlantic Pilot Chart for February. The chart, which is 2 by 4 feet and printed in four colors, illustrates an article by Commander Southerland on the work of the Naval Hydrographic Office. The contents of the magazine for the month also include an illustrated article by William E. Curtis on Macedonia, Bulgaria and Servia, an article by the U. S. Weather Bureau director at Salt Lake City, L. H. Murdock, discussing the fall in the level of Great Salt Lake, an argument by Edwin S. Balch in favor of American Claims in the Antarctic, and miscellaneous geographic notes.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 365th meeting was held Saturday, January 24.

A. D. Hopkins presented a paper on the 'Work of Forest Insects,' fully illustrated with lantern slides, showing two phases of the subject. The first set of pictures illustrated the economic phase, and was suggestive of the destructive character of some of the work, and its relation to public interests.

The first of the principal insects mentioned in this connection was the destructive pine bark beetle (*Dendroctonus frontalis* Zim.), which in 1890 to 1892 devastated the pine and spruce forests of the Virginias, causing the death of many millions of forest and shade trees, over an area of some 75,000 square miles. Evidence has been recently found in Texas that the species committed similar depredations in the long-leaf pine region of eastern Texas between 1882 and 1885. It was evident to the speaker that a number of serious devastations which have occurred in different sections of Southern pine forests within the past century were due to this species.

The pine-destroying beetle of the Black Hills (*Dendroctonus ponderosæ* Hopk.) was also mentioned as one of the most destructive enemies of Western forests. It is now at work in the Black Hills forest reserve, and has already killed some 600,000,000 feet of timber. It is threatening a like fate to the remainder of the timber of the reserve; which involves the destruction not only of the timber, but of the great mining and other industries which are dependent on the timber supply.

The slides also illustrated the work of other species of *Dendroctonus* which had recently been collected in the Priest River forest reserve, Idaho, in western Washington, Monterey, Calif., and Williams, Ariz., where much timber is being killed by different species working in those localities. The destructive work of several species of *Agrilus,* which kill poplars, birches, oaks and chestnuts in different parts of the country, and that of the chestnut timber worm (*Lymexylon sericeum* Harr.), were shown, with the statement that the latter was exceedingly destructive to the chestnut timber of the Appalachian region.

The other set of pictures, illustrating the pure science phase, suggested the importance of biological material as a guide to the determination of true specific characters and characteristics of habit, of the natural relations between primary and minor divisions of bark and wood inhabiting species, and of the relation of species and genera of insects to the species and genera of plants on which they live. It also suggested the importance of

studying such material to determine the course of evolution in the home-building and social habits of some of the bark and wood dwellers. The various forms of the Scolytid gallery were displayed, ranging from the simpler types to the more specialized and symmetrical forms, and charts were exhibited indicating the natural classification of the galleries and how they correspond with the natural classification of the insects.

Under the title 'Evolution, Cytology and Mendel's Laws,' Mr. O. F. Cook noticed the recently published theory that Mendel's laws of the dissociation of parental characters in hybrids are to be explained by the segregation of paternal and maternal chromosomes at the 'reducing division' which precedes the formation of the germ-cells. It was pointed out that this theory is definitely disproved by the very facts which it was intended to explain, since the experiments of Mendel, Spillman and others have shown that the characters derived from different parents may enter into any combinations possible under the law of chance. The germ-cells may be said to be pure in characters but not in parentage. It was further argued that the existence of the 'hereditary mechanism' sought by cytologists is highly improbable, and that heredity is not the function of an organ, but a general property of organisms, to be associated with crystallization and with memory. The facts discovered by Mendel should not be made the basis of a separate generalization, since they characterize but one of four kinds of 'hybrids' representing as many different evolutionary stages.

F. A. Lucas.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 137th meeting of the society, held in the assembly hall of the Cosmos Club, Wednesday evening, January 28, 1903, the following papers were presented:

Mr. S. F. Emmons, 'The Drainage of the Valley of Mexico.'

Mr. Emmons presented a sketch, illustrated by lantern slides, of the various drainage systems of the valley of Mexico, culminating in the elaborate and extensive works recently completed at a cost of over 21½ millions, that carry off not only the surplus waters in time of flood, but also the sewage of the city of Mexico.

He also presented a sketch of the physiography and geology of the valley, together with some speculations as to the probable causes of its change from a valley of the ordinary type to the enclosed area without external drainage of the present day, a change that evidently occurred in very recent time, geologically considered.

Mr. Waldemar Lindgren, 'Notes on the Geology of Molokai, Hawaiian Islands.'

The island is entirely of volcanic origin, and, like some others of the same group, is made up of two old volcanoes separated by a low gap. The western part of the island is a volcanic mountain rising to an elevation of about 1,200 feet. The eastern and most interesting part forms a segment of a circle, the north coast being the chord. The highest peaks rise to nearly 5,000 feet above the sea. While the southern slope is that of a fairly regular volcanic cone and is scored by a great number of ravines, the northern coast is characterized by a great and extremely steep escarpment attaining a height of over 3,000 feet above the sea. Five streams drain this north slope and have eroded deep canyons or alcoves. The escarpment is interpreted as a great fault along which the northern half of the volcanic cone has sunk down below the sea. The peninsula of the leper settlement at the foot of the escarpment is believed to be a part of the thrown block.

At the forks of the stream of Wailau great boulders of coarse diabase were found, indicating that in the upper drainage basin of this stream there are extensive outcrops of this rock, which has not heretofore been known to occur in the Hawaiian Islands.

W. C. Mendenhall,
Secretary.

THE MONTANA ACADEMY OF SCIENCES, ARTS AND LETTERS.

The academy held its first meeting at Bozeman at the same time as the meeting of the State Teachers Association. Three sessions were held, and ten papers were presented.

The strength of the academy was shown by a membership of fifty-eight at the first meeting. With the membership badly scattered in a large state, it was very satisfactory to have an attendance of from fifteen to forty at each session. The sessions were held in the chemical lecture room of the Agricultural College. The following papers were given:

President's Address, 'Montana as a Field for an Academy of Sciences, Arts and Letters,' Morton J. Elrod, University of Montana.

'An Experiment in Temperature as Affected by Altitude,' Morton J. Elrod, University of Montana.

Two thermographs are placed at different altitudes, one at 3,225 feet, the other at 5,100 feet. The instruments have been read weekly since March last. The daily range of temperature is greater at the base than at the summit. During the early fall the higher altitude frequently showed warmer temperature at night than the lower. In October and November the instrument at higher altitude frequently registered more than twenty degrees colder than the one at lower altitude. The mountain top at 5,100 feet frequently showed positive and continuous rise in temperature eight to twelve hours before the effect was noticeable on the lower instrument. It also cools much more quickly than the base. The experiment is being continued, and readings are made regularly.

'A History of Botanical Collecting in Montana,' Dr. J. W. Blankinship, Agricultural College.

This is a very important paper, dealing with the various expeditions and collectors and the collections made by them. Brief histories of expeditions are given, stating the localities to which the expeditions were made, the names of the collectors, the magnitude of the collection, and the institutions in which the herbariums are deposited. Many of the names of collectors have been perpetuated in the names of flowers, now common to botanical collections. The history is carried down to 1898, when the writer began work in the state, and will be completed later. Most of the papers covering the reports of the expeditions are in the library of the agricultural college, as are also many of the important herbariums. The paper is an important contribution to the botanical literature and work in the state.

'An Investigation of Young's Modulus and the Rigidity Modulus of Copper Wire as affected by Twisting the Wire,' Professor J. E. Monroe, State Normal School.

The paper is the result of an experiment in which the wire was twisted a given number of revolutions.

1. The object was to determine the effect quantitatively.

2. A wire was so arranged that each modulus could be determined under the same conditions.

3. First test was made with the wire in its normal condition; then with 10 complete turns taken; then 20 more; then 30 more; and so on until 360 turns were put into the wire, out of which number 332.25 remained.

4. Young's modulus increased quite uniformly from 1.13×10^{12} to 1.159×10^{12} in dynes per sq. cm. The rigidity modulus decreased uniformly from 4.409×10^{11} to 3.702×10^{11} in grams per sq. cm.

5. The wire broke from the torsion at the four hundred and fifth turn. Length of wire, 4.88 meters, diameter, 1.607 mm., density, 8.821.

'Some Montana Geology,' with lantern slides, Professor J. P. Rowe, University of Montana.

'Collecting at High Altitudes,' with lantern slides, Professor M. J. Elrod, University of Montana.

'The Problem of Meaning in the Light of Development,' Dr. Wm. Chandler Bagley, State Normal School.

The combination of conscious elements into meaningful compounds requires an explanation in terms of the elements themselves. Looking upon consciousness as functioning primarily for the modification of reaction, it would seem that the muscular and strain sensations are the most important factors in meaning. These are also quite predominantly 'marginal' sensations, and it is probable from

other sources of evidence that the margin of consciousness carries the meaning. Disturbances of apperceptive functioning in apraxia and sensory aphasia form a basis for a theory of apperceptive degrees which may explain the different meanings which at different times may be read into the same complex of sensations. Flechsig's researches on the functions of the 'silent areas' of the cortex furnish a psychophysical basis for this position. The kinæsthetic theory of meaning is, in general, confirmed by genetic studies of language and by the data of anatomy, especially those facts concerning the increase in the diameter of the pyramidal tracts and the increased differentiation of the muscular system in the higher orders.

The following were read by title:

'Vertical Movements of *Entomostraca*,' M. J. Elrod.

'The Reduction of Nitro Compounds of Benzole,' W. D. Harkins, University of Montana.

'Volcanic Ash Beds of Montana,' J. P. Rowe.

'Caves in Montana,' J. P. Rowe.

J. P. ROWE,
Secretary pro tem.

DISCUSSION AND CORRESPONDENCE.

SMITHSON'S REMAINS.

TO THE EDITOR OF SCIENCE: James Smithson, the founder of the Smithsonian Institution, is about to be turned out of his grave in Genoa, Italy, to make room for a quarry! Why should not the United States Government bring his body to this country and give him a permanent resting place in the grounds of the institution which he founded?

Smithson left his entire fortune 'to the United States of America' to promote 'the increase and diffusion of knowledge among men.' Congress accepted the trust and established 'The Smithsonian Institution' which has done so much to advance science during the last fifty years. Now let the nation that has benefited by Smithson's generosity show its appreciation and gratitude. He left no descendants to care for his remains; let us accept them, too, as a sacred trust and bring them to the United States to be deposited with all reverence in the Smithsonian Institution at Washington. GILBERT H. GROSVENOR.

WASHINGTON, D. C.

THE DESTRUCTION OF FROGS.

TO THE EDITOR OF SCIENCE: The Erie Railroad, near Meadville, Pa., runs parallel to and near French Creek. In the early spring of 1901, at about the time when the frogs were becoming active after their hibernation, I noticed, while walking along the tracks of the above railroad, a number of frogs that had been crushed by the passing trains. I counted no less than thirty-six frogs that had been killed on half a mile of single-track road. One fact noticed was that *nearly every* frog had been cut across the middle line, so that the hind legs lay on one side of the rail, and the fore legs and head on the other side. The rails were the heavy T rails ordinarily used on such roads. At about the same time I noticed on one of the streets of Meadville that was near the creek, a great number of frogs that had been similarly crushed by the electric cars that ran on that street. As the rails of the street railway were laid flush with the level of the street, it was not so surprising that many frogs were crushed, since they were very numerous in that part of town; but how so many of them should be caught on top of a six-inch T rail, and why they should practically all be cut in two, transversely, is not so easy to explain. ALBERT M. REESE.

THE GREAT AUK.

TO THE EDITOR OF SCIENCE: Permit me most emphatically to dissent from the deduction of Professor Hitchcock 'that the great auk was once a resident of Florida, and presumably of the whole Atlantic coast.' This deduction is based on the finding at Ormond, Fla., of two humeri of the great auk in one section of a large shell heap. This is a small basis for so sweeping a generalization, and it is all the smaller in the light of the fact that these two humeri are the only traces of this bird that, so far as I am aware, have come to light south of Block Island, although scores of shell heaps

have been explored and thousands of the bones of other animals recovered. It is quite possible that the great auk may have straggled so far south during severe winters, since there is some reason to believe that it was not rare off the coast of Virginia, but that it was a *resident* anywhere south of Nova Scotia is open to doubt, and that it bred even there is open to argument. Mr. McGuire tells me that foreign vessels traded along the eastern coast of North America to a much greater extent than is generally known, and as the great auk was frequently salted down for ships' stores, it may well have been carried south in this form, and found its way to an Indian village. As bearing on the value of the evidence of stray bones found in shell heaps, it is to be noted that the same part of the heap in which the bones of the great auk were found yielded a humerus of a typical dachshund. (My anthropological friends will cheerfully correct me if I err in saying that this breed of dogs was unknown on the American continent in prehistoric times.) Are we then to at once conclude that the dachshund was common among the Indians? F. A. Lucas.

Washington, D. C.

RECENT ZOOPALEONTOLOGY.

AN UPPER PLIOCENE CAVE.

Professor Boyd Dawkins recently (January 7, 1903) described, before the Geological Society of London, an Upper Pliocene Cave discovered in 1901. This cave is of far greater antiquity than the familiar caves of the Pleistocene and contains a mammalian fauna including the mastodon, elephant, rhinoceros, horse and saber-toothed tiger in an Upper Pliocene stage of evolution, similar to that of the Val d'Arno of Italy. In course of the abstract he says:

"Some of the bones present the characteristic teeth-marks of the hyenas; and the preponderance of the remains of the young over the adult mastodons points to the selection by the hyenas, who could easily master the calves, while they did not as a rule attack the large and formidable adults. The author has observed a similar selection in the case of mammoths in hyena-dens, into which the remains had been brought by those cave-haunting animals." At the same time the author presented a map illustrating the physical geography of the British Isles in the Upper Pliocene Age.

A NEW RHINOCEROS FROM SOUTHERN BAVARIA.

Dr. Ernst Stromer, working in the Paleontological Museum of Munich, has recently described* a new rhinoceros, *Aceratherium bavaricum,* from the Upper Miocene of Bavaria. The skull is of similar type to the well-known *Aceratherium tetradactylum* of Sansan, and the *A. incisivum* of the Lower Pliocene of Eppelsheim. Unfortunately the tip of the nasals is lacking, a fact which renders it difficult to determine to which series of rhinoceroses this animal belongs. (2) The same author gives a valuable summary of the geological history of northern Africa.† (3) He has also published a comparative paper upon the entepicondylar foramen and third trochanter,‡ primitive characters of the fore and hind limbs of mammals. (4) A more extensive work is his memoir entitled 'Die Wirbel der Land-Raubtiere,' based principally upon the extensive collections in the Museum of Munich and worked out at the suggestion of Dr. Max Schlosser.

THE BASAL EOCENE MAMMALIAN FAUNA IN THE FT. UNION BEDS OF MONTANA.

The very important discovery of bones and teeth of mammals in the Ft. Union beds of Montana has been reported by Earl Douglass of the Carnegie Museum, in a paper entitled 'A Cretaceous and Lower Tertiary Section

* 'Ein Aceratherium-Schädel aus dem Dinotherien-Sand von Niederbayern,' Abdr. a. d. *Geognostichen Jahresheften,* 1902. 15. Jahrgang, 1902.

† 'Betrachtungen über die geologische Geschichte Aethiopiens,' Abdr. a. d. *Zeitschr. d. Deutsch. geolog. Gessellschaft,* Jahrg., 1901.

‡ 'Ueber die Bedeutung des Foramen entepicondyloideum und des Trochanter tertius der Säugethiere,' Sep. Abdr. *Morphologisches Jahrbuch,* XXIX., 4.

in South Central Montana.'* In order to settle beyond a doubt the age of these beds a large collection of fossil leaves was made and determined by Mr. F. H. Knowlton, of the U. S. Geological Survey, who reported the species all Ft. Union beyond a doubt. The invertebrates, so far as discovered, are also Ft. Union. The association of these characteristic Ft. Union fossils with basal Eocene mammals such as *Mioclænus, Anisonchus, Euprotogonia* and *Pantolambda* of New Mexico, constitutes one of the welcome geological correlations of recent years, it has been so difficult hitherto to decide as to the age of the Ft. Union beds. The bearing of this discovery on the age of the Puerco and Torrejon is still open to discussion. This correlation may tend to strengthen the suggestion of Professor Cope, who at one time placed the Puerco and Torrejon in an uppermost division of the Cretaceous. Unfortunately the mammals of this formation have no exact counterparts in the oldest Eocene mammals of Europe.

A REVIEW OF THE REPTILIA OF THE TRIAS.

WE are indebted to Friedrich von Huene, of Tübingen, for a valuable preliminary review of the Triassic reptilia in a memoir† of eighty-three pages, illustrated by nine plates. Our knowledge of the Triassic reptiles in general is extremely limited as compared with either that of the Permian reptiles and amphibians, or that of the Jurassic and Cretaceous; yet in the Trias the ancestral types of Plesiosaurs and Ichthyosaurs, of Rhynchocephalia and Testudinata, of Dinosaurs, of Pterosaurs, and of Crocodilia were so near the point of departure from each other, that Triassic skeletons and skulls, when fully known, will give us the clearest insight into the original relationships of these great orders. The volume contains extensive quotations and figures taken from the general literature of the subject, and is fortunately more in the nature of a review and summary of our knowledge than of an attempt still further to increase the nomenclature. Among the valuable new figures, however, is that of the occiput of *Placodus gigas.* The author includes the stegocephalian amphibians and anomodont reptiles of the Karoo formation of South Africa in his list. Of these two groups alone there are 85 genera, out of a total of the 155 genera heretofore described in the Trias. In connection with this special investigation he is especially desirous of securing casts and figures of specimens from the American Trias.

A HORNED EOCENE UNGULATE FROM EGYPT.

THE latest addition to the newly discovered mammalian fauna of northern Egypt is even more peculiar than any which have been described hitherto. Mr. Hugh J. L. Beadnell* gives it the name *Arsinoitherium,* after Queen Arsinöe. The general form of the somewhat long, narrow skull is rhinocerotine; the author indeed compares the dentition with that of the rhinoceros, but so far as we can judge from his figures, the true molar teeth, of which the worn pattern reverses that of the rhinoceroses, do not support this comparison. A most peculiar feature is the enormous protuberance rising out of the anterior half of the skull-top, bifurcating and slightly flattening toward the top, somewhat in the same manner as the horns of the later species of Titanotheres. These bony 'horns' reached the height of 68 cm., as compared with the total length of the skull, 75 cm. To strengthen their support at the base, a vertical bone or septum is carried down, uniting with the premaxillaries, as in certain of the heavy-horned rhinoceroses. The animal was as large as one of the larger rhinoceroses, the pelvic girdle having a transverse extent of 140 cm. Further accounts of this pachyderm will be awaited with the greatest interest. It demonstrates that, in addition to the fauna an-

* *Proc. Amer Philos. Soc.,* April 3, 1902, pp. 207–224.

† 'Übersicht über die Reptilien der Trias,' *Geol. u. Palæont. Abh.,* E. Koken, N. F. VI., Heft 1, Jena, 1902.

* 'A Preliminary Note on Arsinoitherium zitteli, Beadn., from the Upper Eocene Strata of Egypt,' Survey Department, Public Works Ministry, Cairo, 1902.

cestral to that which subsequently found its way into Europe, Africa had a very distinctive ungulate fauna of its own. H. F. O.

RESEARCH FUNDS OF THE SCIENTIFIC ALLIANCE OF NEW YORK.

The council of the Scientific Alliance of New York holds two funds, the income from which is used for the aid of investigation by persons who are members of one or more of the societies composing the alliance.

An account of the operation of these funds, up to the present time, is given herewith.

The John Strong Newberry Fund.—The plan for the administration of this fund, established as a memorial of Professor Newberry, was adopted by the council of the Scientific Alliance on February 25, 1897, and at the same time a grant of $50 was appropriated for research in geology or paleontology. On June 14, 1897, this grant was awarded to Dr. Arthur Hollick for aid in his study of the geology and paleontology of the Atlantic Coastal Plain; during the summer of 1897 Dr. Hollick prosecuted work in New Jersey and on Long Island and Block Island with the special object of tracing the Cretaceous formation to the latter locality, where its presence had long been assumed but not proved. Dr. Hollick secured the evidence desired by the discovery of a number of species of well-known Cretaceous plants. The results of these investigations were published in the *Annals of the New York Academy of Sciences,* XI., 55–88, pls. II.–IX.), under the title 'Notes on Block Island,' which was subsequently reprinted as 'Contributions from the Geological Department of Columbia University, No. XLII.'

The second grant from this fund, $50, was awarded by the council on June 22, 1898, to Mr. Gilbert Van Ingen for aid in research in paleontology. Mr. Van Ingen utilized the money in the study of the Silurian Fauna of Arkansas, and his results are published under the title 'The Siluric Fauna near Batesville, Arkansas' in *School of Mines Quarterly,* XXII., 318–329 (1901), in which the geological relations are discussed, and also in the same journal, XXIII., 34–74 (1901), where the trilobites of that fauna are described.

A third grant of $50 was awarded May 18, 1899, to Professor E. S. Burgess for aid in his studies of the genus *Aster.* Professor Burgess, who has been studying this difficult genus of plants with close attention for many years, is now just about completing his monograph upon them, and it will be printed in *Memoirs of the Torrey Botanical Club;* some of the results of this study were incorporated by him in the treatment of the genus *Aster* in the 'Illustrated Flora of the Northern States and Canada' by N. L. Britton and Addison Brown, also in 'Manual of the Flora of the Northern States and Canada' by N. L. Britton, and have also been used in 'The Flora of Southeastern United States' by J. K. Small.

The fourth grant from the fund, also $50, was awarded May 17, 1900, to Dr. Marshall A. Howe, for assistance in his investigation of the algal flora of the Atlantic coast of the United States. Dr. Howe spent some time on the coast of New England and on the Bermudas, making extensive collections of the seaweeds of both regions; his studies have not yet been sufficiently advanced to enable publication to be made of them, but it is expected that some of his papers will be printed within a few months.

The fifth grant was for $100, a friend of the alliance having added enough money to the annual interest on the fund to make up this amount, and it was authorized February 28, 1901. It was awarded to Dr. Arthur Hollick for assistance in the continuation of his studies upon the paleontology of the Atlantic Coastal Plain. Dr. Hollick's field work, by means of this grant, was carried out for the most part upon Cape Cod and Chappaquidick Island, Mass., where the furthest eastward extension of the Cretaceous formation was shown to occur, by means of the fossil plants collected, and a summary of his results under the title 'Geological and Botanical Notes: Cape Cod and Chippaquidick Island, Mass.,' is published in the *Bulletin of the New York Botanical Garden,* II., 381–407.

A sixth grant of $50 was authorized May

15, 1902, and it has been recommended by the committee on the fund, and approved by the council, that the award be made to Miss Ida M. Ogilvie, for assistance in her studies of the Strombidæ.

The Herrman Fund.—The principal of this fund amounts to $10,000. This money was presented to the council of the alliance by Mrs. Esther Herrman in January, 1899, as a nucleus of a building fund, and with the consent of Mrs. Herman, the interest upon it is being temporarily used for the encouragement and assistance of investigation. Rules for its administration were adopted by the council in October, 1902, and the following grants have been made:

1. To Professor L. M. Underwood, of the Torrey Botanical Club, for aid in his investigations upon the ferns of tropical America, $200. Professor Underwood is now in Jamaica and will visit Cuba and other West Indian Islands during the next few months.

2. To Professor J. McK. Cattell, of the New York Academy of Sciences, for aid in his investigation on the natural history of American men of science, $200.

N. L. BRITTON,
Secretary of the Council Scientific Alliance of New York.

FIFTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

I HAVE received the following communication dated December 3, 1902, from Dr. Geo. Pulvermacher, Secretary of the Fifth International Congress of Applied Chemistry to be held in Berlin, beginning May 31, 1903, with the request that it be published in SCIENCE:

The preparations for the Fifth International Congress of Applied Chemistry, which will meet in Berlin during Whitsuntide of this year and which will be the first of its kind on German soil, are advancing in a satisfactory manner. All expectations with reference to a successful session will no doubt be fulfilled to the greatest degree. The membership of the general committee and the organization committee has increased to about one hundred and fifty. We find as members of the general committee the Imperial Chancellor, all the secretaries of the various states and individual members of the same, the presidents of the Imperial Health Department, of the Patent Office as well as the Imperial Insurance Department, the ministers of the German Confederate States, almost all Prussian provincial ministers, representatives of many Prussian authorities and representatives of all German Confederate States. Furthermore, twelve members of the high courts, six members of the municipal council and common council, with the Chief Burgomaster and presiding officer of the common council at the head, and numerous representatives of various industries.

About sixty of the most prominent representatives of German science and industry compose the organization committee and are making the requisite arrangements. An extensive fund for the expenses of the Congress has been subscribed and is in the hands of the treasurer of the Congress, Deputy Doctor Böttinger.

The foreign states whose governments received notice of the Congress through diplomatic channels and who were requested to send delegates have formed separate organization committees which are in constant communication with the organization committee in Berlin. A large attendance both from European and foreign countries is expected.

The work of the congress will be done in eleven sections. The President of the congress, Professor Dr. Otto N. Witt, in conjuction with the presiding officers of the individual sections, has fixed the basic principles for the scientific arrangement of the congress. The sections have been divided as follows:

1. Analytical chemistry, apparatus and instruments; presiding officer, Professor Dr. G. von Knorre, Charlottenburg, Technische Hochschule.

2. Chemical industries of inorganic products; presiding officer, Dr. Heinecke, Berlin N. W., Wegelystr.

3. Metallurgy and explosives; presiding officer, Professor Dr. J. Weeren, Charlottenburg, Stuttgarterplatz, 13.

4. Chemical industries of organic products.

(*a*) Organic preparations including tar products; presiding officer, Professor Dr. H. Wichelhaus, Berlin, N. W., 40, Grosse Querallee, 1.

(*b*) Dyes and their application; presiding officer, Dr. Lehne, Grunewald, Trabnerstr. 9.

5. Sugar industry; presiding officer, Professor Dr. Herzfeld, Grunewald, Gillstr. 12.

6. Fermentation industries and starch manufacture; presiding officer, Professor Dr. H. Delbruck, Berlin W. 15, Fasanenstr. 44.

7. Agricultural chemistry; presiding officer, Professor Dr. Wagner, Darmstadt.

8. Hygiene, medical and pharmaceutical chemistry, foods; presiding officer, Dr. E. A. Merck, Darmstadt.

9. Photo-chemistry; presiding officer, Professor Dr. A. Miethe, Charlottenburg, Kantstr. 42.

10. Electro-chemistry and physical chemistry; presiding officer, Dr. H. T. Böttinger, Elberfeld.

11. Judicial and economic questions associated with chemical industries; presiding officer, Dr. C. A. Martius, Berlin, W. 9, Vossstr. 12.

These sections have been formed and have held sessions in which all matters placed before them have been discussed. Each section will submit certain questions of general and international importance for which referees and coreferees have been appointed and whose treatment will include a discussion as well as an eventual resolution which will be placed before the congress in its final general session. Furthermore, each section has already received a number of papers from scientists both local and foreign. The three general sessions will include the official opening and closing addresses, and a number of detailed lectures by prominent representatives of the sciences and industries of different countries.

A series of especially important questions in the field of analytical chemistry is now under consideration by a special international commission.

A separate exhibit of apparatus and preparations will not be held by the congress. It is, however, certain that the members will have numerous opportunities to become acquainted with improvements in the various provinces of chemistry. Lectures with demonstrations will be allowed in the sessions of the individual sections. Both the general section sessions will be held in the hall of the Reichstag. Only section 10, electro-chemistry and physical chemistry, will, on account of the experiments connected with the addresses, hold its sessions in the auditorium of the Physical Institute.

A local committee has been formed, of which Dr. J. F. Holtz is chairman. An extensive program of entertainments has been prepared. An informal meeting at some suitable place has been planned for the evening of June 2, after the meeting in the hall of the Reichstag. A banquet and a commers will be held during the week. The city of Berlin will give a festival in honor of the members of the congress. A performance at the opera house and a garden festival are also planned. An excursion to various points of interest in the vicinity of Berlin will close the week.

Invitations to the congress, which contain all details of interest to those who will participate, will be sent during January to the addresses collected during the last two years, from all countries of the world. About 50,000 copies will be distributed.

Communications and inquiries concerning the congress should be addressed to the bureau, Charlottenburg, Marchstrasse, 21.

Since the publication of the first list of the American committee, the following changes have been made:

M. E. Jaffa, of the University of California, present address Middletown, Conn., has been appointed chairman of section 8, in place of Dr. W. O. Atwater, and Dr. Leo Baekeland, Snug Rock, Yonkers, N. Y., chairman of section 9, in place of Dr. L. H. Friedburg.

Word has been received from Dr. Pulvermacher that circulars of information, etc., have been sent to the chairman of the American committee for distribution to interested American chemists. Already a list of considerable magnitude of the names of such

chemists has been compiled, but it is far from complete. All interested in receiving these circulars of information should address a request to that effect to the chairman of the American Committee on Organization.

Intending members are requested to send a check for $4.85 to Dr. H. W. Wiley, U. S. Department of Agriculture, Washington, D. C., who will give a receipt therefor and transmit the amount to Berlin.

Titles of papers should be sent to the American chairmen of the various sectional committees. (See Science, No. 414, December 5, 1902, p. 899.)

It is hoped that the interest which has already been manifested by American chemists in this congress will continue, and that next to Germany we may have the largest number of members enrolled.

H. W. Wiley,
Chairman, American Committee on Organization.

SCIENTIFIC NOTES AND NEWS.

Dr. Albert B. Prescott, professor of chemistry in the University of Michigan, has been given the degree of LL.D. by Northwestern University.

Dr. Karl Gegenbaur, professor of anatomy at the University of Heidelberg, has been made a knight of the Prussian order 'Pour le merite'; and Professor Luigi Cremona, director of the School of Engineering at Rome, has been made a foreign member of the same order.

Dr. Friedrich Schottky, professor of mathematics at Marburg, has been elected a member of the Berlin Academy of Sciences.

The Carnegie Institution has made a grant of $1,000 to Professor H. V. Wilson of the University of North Carolina, for the prosecution of an investigation on the morphology and classification of sponges.

Professor S. W. Williston, of the University of Chicago, has received a grant from the Carnegie Institution for a monographic study of the plesiosaurs. Professor E. C. Case, of the State Normal School of Milwaukee, Wis., has received a similar grant to aid him in researches on the Permian reptiles.

A press despatch states that the Carnegie Institution has made grants of money to professors of the Johns Hopkins University as follows: Professor R. W. Wood, professor of experimental physics, $1,000 to maintain a research assistant in his laboratory; Dr. H. N. Morse, professor of analytical chemistry, $1,500 to enable him to retain the services of an assistant during the current year in his investigations upon his newly discovered method of measuring osmotic pressures; Dr. Harry C. Jones, professor of physical chemistry, $1,000 for an assistant; and Dr. J. J. Abel, professor of physiological chemistry, $1,000 for the purchase of apparatus necessary in his work.

Professor E. B. Poulton, of Oxford University, has been elected president of the Entomological Society of London.

An Electrochemical Society has been established in Great Britain, with Dr. J. W. Swan as president. The vice-presidents are Professor A. Crum-Brown, Sir Oliver T. Lodge, Dr. Ludwig Mond, Lord Rayleigh, Mr. Alexander Siemens and Mr. J. Swinburne.

Mayor Low, of New York city, has appointed a commission to pass on the plan of the new Manhattan bridge over the East River, consisting of Lieut. Col. Charles W. Raymond, U.S.A., Mr. George S. Morrison, Mr. Charles C. Schneider, vice-president of the American Bridge Company; Mr. Henry W. Hodge and Professor Mansfield Merriman, of Lehigh University.

Professor W. S. Franklin, of Lehigh University, delivered a lecture before the Pittsburgh Academy of Science, on February 5, on the subject of 'Lens imperfections and their compensation.'

Professor Conway MacMillan, of the University of Minnesota, is recovering from a serious attack of typhoid fever which has kept him from the university since January 6.

Joseph Burtt Davy, instructor in botany in the University of California, has accepted the position of state agrostologist and botanist

to the Department of Agriculture of the Transvaal government, with headquarters in Pretoria.

Father Edmund Goetz, S.J., who has recently been in this country and is now in Paris, is to take charge of an astronomical, magnetic and meteorological observatory which is to be situated at Buluwayo, Rhodesia, South Africa.

Dr. T. G. Brodie, lately director of the laboratories of the Royal Colleges, London, succeeds Dr. J. Rose Bradford as superintendent of the Brown Animal Sanatory Institution.

We learn from *The British Medical Journal* that Dr. A. S. F. Grünbaum has been appointed director of the Cancer Research for which Mr. Sutton Timmis, of Liverpool, has recently generously initiated a fund by a donation of £10,000. The work is to be carried on in connection with University College and the Royal Infirmary, Liverpool.

The committee of the Royal Society appointed to investigate the 'sleeping sickness' in Uganda has received reports from the observers whom they despatched to Uganda in July last. The investigations so far carried out not being considered conclusive, the committee, in view of the great gravity of the situation, have obtained the consent of Lieutenant-Colonel Bruce, F.R.S., one of their own members, to proceed at once to Uganda to superintend further investigations into this disease.

Dr. Jean Charcot, of Paris, will leave in May with a staff of scientific experts for arctic explorations north of Franz Josef Land and Nova Zembla.

The senate has passed a bill pensioning the widow of the late Colonel Walter Reed at the rate of $125 a month. The house committee on pensions has given a hearing on the bill providing for a pension of $4,000 a year. Those invited to address the committee included President Gilman, of the Carnegie Institution; Professor William Welch, of Johns Hopkins University; Dr. Alexander Graham Bell and Surgeon-General Robert O'Reilly, U.S.A.

We learn from *Nature* that an influential committee has been formed in Rome to take measures to honor the memory of Father A. Secchi, S.J., the distinguished astronomer and meteorologist, on the occasion of the twenty-fifth anniversary of his death, which occurred on February 26, 1878. The president of the committee, Father G. Lais, S.J., vice-director of the Vatican Observatory (address, Via Torre Argentina, 76, Rome), will be glad to add the names of scientific men and institutions to the list of those interested in this celebration.

The Rev. Norman Macleod Ferrers, D.D., F.R.S., since 1880 master of Gonville and Caius College, Cambridge, died on January 31 in his seventy-fourth year. He was senior wrangler in 1851. He for a time edited the *Quarterly Journal of Mathematics* in conjunction with the late Professor Sylvester, and made numerous contributions to that journal. His best known work was a treatise on spherical harmonics.

Mr. James Glaisher, F.R.S., well-known for his work in meteorology and aeronautics, has died at the age of ninety-four years. He was for many years superintendent of the meteorological department of the Greenwich Observatory.

Dr. David George Ritchie, professor of logic and metaphysics at St. Andrews University, died on February 3, aged fifty years. He was from 1878 to 1894 fellow of Jesus College, Oxford. He was the author of numerous articles and books on philosophy, political science and ethics. Though belonging to the group of philosophical students influenced by Thomas Hill Green, he was well acquainted with modern science and published in 1899 a book entitled 'Darwinism and Politics.'

Professor Edward R. Shaw, recently elected superintendent of Public Schools of Rochester, N. Y., and until recently dean of the New York University School of Pedagogy, died on February 11.

The deaths are also announced of M. Sirodot, honorary professor at Rennes and a corresponding member in botany of the Paris

Academy; of Joseph Chavanne, the Austrian geographer and meteorologist, and of Dr. Rudolf Franz, a Berlin physicist.

THE bill creating a department of commerce, with a secretary in the cabinet, has passed the house and senate. The new department will consist of the Bureau of Corporations, the Bureau of Labor, the Lighthouse Board, the Lighthouse Establishment, the Steamboat Inspection Service, the Bureau of Navigation, the Bureau of Standards, the Coast and Geodetic Survey, the Commissioner General of Immigration, the Commissioners of Immigration, the Bureau of Immigration and the immigration service at large, the Bureau of Statistics of the Treasury Department, the Shipping Commissioner, the Bureau of Foreign Commerce (now in the Department of State), the Census Bureau, and the Fish Commission.

THE senate judiciary committee has made a favorable report on the bill to establish a laboratory for the study of the criminal, pauper and defective classes, a similar bill having been reported favorably by the house judiciary committee.

IT will be remembered that last year congress made an appropriation of $5,000 to prepare plans for the building for the National Museum. We understand that the tentative plans have been prepared and transmitted to the House of Representatives. They call for a fireproof steel brick and terracotta building to cost $3,000,000, only one half of which is to be erected at present. It is to be hoped that congress will find time to attend to the matter, as it is universally admitted that the present building is entirely inadequate.

ANNOUNCEMENT has been published to the effect that the land purchased for the Rockefeller Institute for Medical Research is part of the old Schermerhorn farm. It extends from Avenue A to the East River, and from 64th to 67th St. The price paid for the land is reported to be $700,000, and it is said that the laboratory to be erected on it will be the most complete institution of its kind in the world.

MR. ANDREW CARNEGIE will erect a library at Atlantic City at a cost of $60,000; and one at Dover, England, at a cost of £10,000.

THE Imperial Academy of Sciences of St. Petersburg in cooperation with the government offers 7,500 roubles in prizes for research solving the cause of poisoning through the use of salted raw fish. The papers, which may be in English, must be presented by January 1 next.

THE Michigan Academy of Sciences meets at the University of Michigan on March 26, 27 and 28.

THE French Congress of Scientific Societies will hold its forty-first annual meeting at Bordeaux from April 14 to 18.

THE International Congress of Historical Science will meet at Rome from April 2 to 9. One of the eight sections is devoted to the history of science.

THE Linnean Society of London has taken action to alter its charter so that hereafter women may be elected as fellows.

IT is reported that German explorers have recently discovered a fossil horse in central Africa. We may soon look for rapid extension of our knowledge of the fossil Equidæ of this continent.

THE United States Geological Survey, in cooperation with the state of Maine, has recently issued a new map of the region surrounding the entrance to the Penobscot River, known as the Castine quadrangle. The map is uniform with the maps already issued by the government of other parts of the state. It differs from the charts issued by the Coast and Geodetic Survey in giving the details of features on the islands and the mainland, whereas the latter maps are confined almost exclusively to the marine features of the region—soundings, channels and the outlines of the coast. Like other maps of the Geological Survey, the Castine sheet illustrates the topography or relief of the land features, giving at the same time in great detail all roads, settlements and rivers, and, in addition, the elevation above sea level of all parts of the region shown.

UNIVERSITY AND EDUCATIONAL NEWS.

The Goldsmiths Company that some time since purchased the economic library of Professor Foxwell for $50,000, has presented it to the University of London with an endowment of $50,000 a year for five years.

The debt of Bristol University College, amounting to $25,000, has been cleared by subscriptions including two of $5,000 from Sir William Wills and Sir Frederick Wills.

The Carnegie Trustees are elaborating a scheme to provide funds to the four Scottish Universities for the purpose of endowing post-graduate research.

A course on forestry has been established at the University of Toronto.

A meeting of about fifty members of congregation at Oxford passed without dissent a resolution recommending that candidates for honors in mathematics and natural science be not required to pass an examination in Greek on entering the university. Congregation has passed a resolution exempting students who have passed the *Abiturienten* examination at a Gymnasium in Germany, Austro-Hungary, or Switzerland from responsions.

It is hoped that the Rhodes scholars from Cape Colony, Natal, and Rhodesia may be elected in time to go into residence at Oxford in October next and also the first students from Germany, who are to be appointed by the German Emperor, but the other scholarships will not commence before October, 1904.

Most of the regents of the University of the State of New York have signed a memorial address to the governor, legislature and people of the state of New York asking that the exclusive power and duty of supervising public education to the state be committed to them. At the same time a bill has been introduced at Albany organizing a state board of education within the board of regents. According to this bill, nine regents of the university would be elected by the legislature forming a board of education, who would elect a superintendent of public instruction and supervise the primary and secondary schools.

Pursuant to the suggestion of President Butler, the members of the various departments of Columbia University have grouped themselves together into divisions. The organization of the divisions dealing with scientific subjects is as follows:

Biology, comprising the Departments of Anatomy, Bacteriology, Botany, Physiology, Physiological Chemistry and Zoology—Chairman, Professor John G. Curtis; Secretary, Professor Bashford Dean.

Chemistry, comprising the Departments of Chemistry and Physiological Chemistry—Chairman, Professor Chas. F. Chandler; Secretary, Dr. Henry C. Sherman.

Geology, Geography and Mineralogy, comprising the Departments of Geology, Geography and Mineralogy—Chairman Professor Alfred J. Moses; Secretary, Dr. Lea McI. Luquer.

Mathematical and Physical Science, comprising the Departments of Astronomy, Mathematics, Mechanics and Physics—Chairman, Professor J. Howard Van Amringe; Secretary, Dr. William S. Day.

Mining and Metallurgy, comprising the Departments of Metallurgy and Mining—Chairman, Professor Henry S. Munroe; Secretary, Mr. J. F. McClelland.

Philosophy, Psychology and Anthropology, comprising the Departments of Anthropology, Philosophy and Psychology—Chairman, Professor J. McK. Cattell; Secretary, Dr. Adam Leroy Jones.

John Henry MacCracken, president of Westminster College, at Fulton, Mo., has resigned to become assistant to his father, the chancellor of the New York University.

Mr. Bruce Fink, of the Upper Iowa University, has accepted the chair of botany at Iowa College, and will assume the duties in September.

Professor Karl Marbe has been appointed professor of psychology at Wurzburg.

Mr. P. A. Smith has resigned as instructor in mathematics in the University of Illinois to accept a position in the Hiroshina Higher Normal School of Japan.

The Lucasian professorship of mathematics at Cambridge, vacant by the death of Sir George Gabriel Stokes, will be filled on February 28. The electors are the heads of the several colleges of the University.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 27, 1903.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.

THE second winter meeting of this society was held in Washington, D. C., during convocation week, in affiliation with the American Association for the Advancement of Science.

On Monday, December 29, at 4 P.M., over two hundred persons assembled in the lecture room on the first floor of the Law Building of the Columbian University to hear the address of the president of the society, Professor Simon Newcomb. This address has already appeared in SCIENCE.

Three sessions of the society for the reading of papers and transaction of business were held in the Assembly Hall of the Cosmos Club, Tuesday, Wednesday and Thursday afternoons, the average attendance being about seventy-five.

Tuesday evening the annual dinner was given at Maison Raucher. Among the forty-three present were a number of ladies and, as guests, His Excellency, the Im-

perial German Ambassador; Hon. J. T. Morgan, U. S. Senate; the Assistant Secretary of State; and the Superintendent of the Naval Observatory. A most enjoyable evening was spent together, among the good things being addresses by the guests, by Professor Newcomb, and by Professor Hale.

On Wednesday afternoon the session was adjourned shortly before 4 o'clock, to enable the members of the society to attend a reception given them by the Superintendent of the Naval Observatory and Mrs. Chester. After a most pleasant social gathering for an hour or more, all present were invited to spend as much of the evening as they chose inspecting the observatory and its instrumental equipment.

At the final session resolutions were adopted tendering the thanks of the society to Captain Chester, the Superintendent of the Naval Observatory, for his courteous invitation to visit the observatory, and his kind attentions during the meeting of the society; also tendering the thanks of the society to the Cosmos Club, for the use of the club house and of all its facilities so courteously accorded to the society and its members.

During the meeting seventeen new members were elected, and the selection of a time and place for the next meeting was left open for future action by the council.

The officers elected were:

For 1903.

President—Simon Newcomb.

First Vice-President—Geo. E. Hale.

Second Vice-President—W. W. Campbell.

Treasurer—C. L. Doolittle.

For 1903–4.

Councilors, Ormond Stone, W. S. Eichelberger.

For 1903–4–5.

Secretary—Geo. C. Comstock.

PAPERS PRESENTED.

Harold Jacoby: 'Comparison of Astronomical Photographic Measures made with the *réseau* and without it.'

George E. Hale, Ferdinand Ellerman and J. A. Parkhurst: 'The Spectra of Stars of Secchi's Fourth Type.'

W. J. Humphreys: 'On Certain Matters Connected with Spectroscopic Methods.'

E. B. Frost and W. S. Adams: 'Radial Velocities of Twenty Stars having Spectra of the Orion Type.'

E. B. Frost and W. S. Adams: 'New Spectroscopic Binaries.'

E. B. Frost and W. S. Adams: 'The Wave-lengths of Rydberg's First Line of Hydrogen (λ 4686) and Others.'

W. S. Adams: 'The Orbit of the Spectroscopic Binary η Orionis.'

E. O. Lovett: 'Periodic Solutions of the Problem of Four Bodies.'

E. O. Lovett: 'On the Integrals of the Problem of n Bodies.'

G. C. Comstock: 'The Masses in 85 Pegasi.'

F. W. Very: 'Form and Structure of the Galaxy.'

S. A. Mitchell: 'The New Gases, Neon, Krypton and Zenon in the Chromosphere.'

G. C. Comstock: 'Preliminary Account of an Investigation of the Proper Motions of Faint Stars.'

Sarah F. Whiting: 'Astronomical Laboratory Work for Large Classes.'

F. W. Very: 'An Inquiry into the Cause of the Nebulosity Around Nova Persei.'

G. W. Hough: 'Improvement in the Mounting of Fixed Meridian Instruments.'

J. A. Parkhurst: 'Photometric and Photographic Observations of Faint Variable Stars.'

S. C. Chandler: 'The Probable Value of the Aberration Constant.'

C. L. Doolittle: 'Constant of Aberration from Zenith Telescope Observations, 1901–1902.'

E. F. Nichols and G. T. Hull: 'The Pressure of Light and its Illustration in the Construction of a Laboratory Comet's Tail.'

E. E. Barnard: 'On the Micrometrical Triangulation of the Stars in the Great Globular Clusters, M. 3, M. 5, M. 13 and M. 92.'

E. E. Barnard: 'Observations and Light Curves of some of the Small Variable Stars found in the Globular Clusters.'

A. O. Leuschner: 'Notes on the Short Method of Determining Orbits from Three Observations.'

A. O. Leuschner: 'A Method of Computing Orbits in Rectangular Coordinates.'

A. O. Leuschner: 'The Solution of the Orbit Irrespective of Parallax and Aberration.'

A. O. Leuschner: 'The Orbit of Comet 1902 a.'

G. H. PETERS: 'The Photoheliograph of the U. S. Naval Observatory; its Use and Defects in Solar Photography.'

SIMON NEWCOMB: 'Statement of the Progress made by the Watson Trustees in Computing Tables of the Asteroids discovered by James C. Watson.'

A. S. FLINT: 'Results of Meridian Observations for Stellar Parallax made at the Washburn Observatory.'

L. A. BAUER: 'Preliminary Summary of Magnetic Results obtained during the Recent Eruption in Martinique.'

S. D. TOWNLEY: 'The Light of the Stars.'

ABSTRACTS OF PAPERS.

Comparison of Astronomical Photographic Measures Made with the Réseau and without it: HAROLD JACOBY.

The *réseau* method of measuring stellar photographs, as considered in the present note, is similar to that in use by the observatories participating in the photographic survey of the heavens now in progress. The most important advantage of this method of measurement is that it avoids almost altogether the effects of possible contractions or expansions of the sensitive film during development; and to this advantage has been joined another of a practical character which was perhaps not foreseen by the originators of the *réseau* method. It is found most confusing to measure plates having nothing on their surfaces but stars-images; in fact, in the case of close clusters, it is well-nigh impossible on such plates to make sure that the two coordinates assigned to any star really belong to the same object. All this possibility of confusion disappears, however, with *réseau* plates, as it is easy to keep all measures in order by considering each little square by itself.

As usual, there are compensating disadvantages connected with the *réseau.* It is necessary, for instance, to make certain assumptions, such as the following:

1. That the division errors of the original *réseau* can be determined as accurately as those of a scale.

2. That the photographic copy of the *réseau,* as it appears on the star-plate, really reproduces exactly the division errors of the original.

3. That the bisection of the photographed *réseau* lines on the star-plate can be made with a microscope as accurately as the lines of a scale can be bisected.

It is of course possible to discuss each of these assumptions separately; but in the present note I shall consider one simple experiment only. This consisted in measuring a couple of Pleiades photographs twice, once by the *réseau* method, and once with a metallic scale. A simple comparison ought then to show how far the two methods of measurement differ in their results. Seventy-five stars were observed in each case, and the same stars were used. The first plate was made at Paris, January 14, 1901, and the 'probable discordance' between the two methods of measurement was $\pm 0''.11$. No corrections were applied for possible division errors of the Paris *réseau,* as none have been published, though the MM. Henry have satisfied themselves that the Paris *réseau* errors are inappreciable. The second plate was made at Helsingfors, December 12, 1900, and gave a probable discordance of $\pm 0''.22$. In this case, the measures were corrected with Donner's division errors, but these are not large enough to affect the result appreciably. In both cases, measures made with the metallic scale were corrected for the division errors determined at Columbia University. The larger discordance in the case of the Helsingfors plate is probably due to the less well defined character of the photographed *réseau* lines. In many cases it is impossible to bisect these lines under the microscope any-

where except at the corners of the squares, where two lines cross and form a point.

But when we consider that the above discordances involve the errors of both measurements, they do not appear unduly large. Divided by $\sqrt{2}$, they give for the probable error of a measurement by one method only $\pm$ 0″.08 for Paris, and $\pm$ 0″.16 for Helsingfors; and there is no evidence of a systematic arrangement of signs in the differences between the two methods. We may conclude, therefore, that plates measured by the *réseau* method and without it give identical results within a very narrow margin; nor does irregular distortion of the film appear to have affected appreciably the measures made without the *réseau.*

The Spectra of Stars of Secchi's Fourth Type: GEORGE E. HALE, FERDINAND ELLERMAN and J. A. PARKHURST.

In his early surveys of stellar spectra, Secchi divided the red stars into two great classes (his third and fourth types), whose spectra differ very markedly in their general characteristics. Subsequent investigations by Vogel and Dunér confirmed Secchi's conclusion with regard to the presence of carbon bands in the spectra of stars of the fourth type, but in view of the instrumental means employed it was impossible for these investigators to distinguish the individual lines in the spectra. An investigation of these stars was accordingly undertaken with a three-prism spectrograph, used in conjunction with the forty-inch refractor and the two-foot reflector of the Yerkes Observatory. Some 250 photographs, ranging in exposure-time from a few minutes up to twenty-five hours, were made. They include the yellow and green as well as the blue regions of the spectra. A special study has been made of eight stars, in whose spectra the wave-lengths of several hundred bright and dark lines have been measured. The presence of bright lines, though suspected by Secchi, was denied by subsequent observers, but has been abundantly confirmed by the present photographs. Hitherto it has not been possible to identify these lines. A large part of the dark lines, however, have been found to be due to iron, titanium and various other substances. By the aid of these lines the radial velocities of the eight stars have been determined. The photographs bring out a marked resemblance between the spectra of the two classes of red stars, so far as the dark lines are concerned. Cyanogen is present in both classes, but carbon, either alone or in combination with oxygen, is absent from stars of Secchi's third type, while very conspicuous in stars of the fourth type. In both classes of stars the relative intensities of the dark lines in the spectrum of a given element seem to differ considerably from the corresponding intensities in the solar spectrum. This led to a comparison of the stellar lines with the widened lines in the spectra of sun-spots. So far as can be judged from the present photographs, there is a marked similarity of these spectra, but this can not be made the basis of any theoretical conclusions before further investigations with higher dispersion have been made. In general, the investigation tends to confirm the opinion of Vogel and Dunér that the two classes of red stars have developed from solar stars. Full details of the work, with tables of wave-lengths and reproductions of photographs, will appear soon in the *Publications of the Yerkes Observatory.*

Radial Velocities of Twenty Stars having Spectra of the Orion Type: EDWIN B. FROST and WALTER S. ADAMS.

This paper represents a part of the work done during the past year with the new

Bruce spectrograph of the Yerkes Observatory. Stars with spectra of this interesting type, which seems certainly to characterize an early stage of stellar development, have not hitherto received much attention in respect to motion in the line of sight. These spectra are not adapted to measurements of any such degree of accuracy as is possible for the solar stars, because of the comparative fewness and the generally hazy and ill-defined character of their lines. The results have, however, proved more accordant than was anticipated. The general good adjustment and trustworthiness of the spectrograph are attested by the measures of the moon's radial velocity. The twelve lunar spectra photographed during the year gave a mean difference of 0.2 km. per sec. between the observed and the computed radial velocity, the largest difference being 0.7 km. per sec. The titanium spark was chiefly used for furnishing the comparison spectrum, but the iron and the chromium spark and a helium tube were also employed at times. A perfectly definite amount of self-induction and capacity was always maintained in the secondary circuit.

The lines commonly present and measured in the stellar spectra were those due to one or more of the following elements: helium, oxygen, silicon, nitrogen, hydrogen, magnesium. The observing list included about 150 stars of this type brighter than the sixth magnitude. The present paper included only those of which three or more plates have been obtained and measured. Those found to vary in their radial velocity, six in number, were not included in the discussion. The stars of the *Orion* type are peculiarly distributed in the sky, being for the most part grouped in or near the Milky Way. As many of the twenty are near the apex or anti-apex of the sun's way, the observed velocities clearly show the effect of the solar motion. If a correction were applied for this motion, the resulting absolute radial velocities would be small. The angular proper motions of these stars are also small, and suggest a relatively great distance from our sun, as well as a 'community of interest' of these stars. The radial velocities observed, expressed in kilometers per second, are as follows:

γ *Pegasi*	+ 5	ε *Can. maj.*	+ 27
ζ *Cassiopeiæ*	+ 3	η *Leonis*	+ 4
ε *Cassiopeiæ*	— 6	γ *Corvi*	— 7
ζ *Persei*	+ 22	τ *Herculis*	— 13
β *Orionis*	+ 21	ζ *Draconis*	— 14
γ *Orionis*	+ 18	ι *Herculis*	— 16
ε *Orionis*	+ 26	67 *Ophiuchi*	— 4
ζ *Orionis*	+ 17	102 *Herculis*	— 11
κ *Orionis*	+ 17	η *Lyræ*	— 9
β *Can. maj.*	+ 33	ε *Delphini*	— 26

(Paper will appear in full in the 'Decennial Publications of the University of Chicago.')

New Spectroscopic Binaries: EDWIN B. FROST and WALTER S. ADAMS.

During the observations described above, six stars of the *Orion* type were found whose radial velocity varied. Preliminary statements have already been published as to three of these (η *Orionis,* o *Persei,* β *Cephei*). The others are δ *Ceti,* ζ *Tauri* and ν *Eridani.* Of δ *Ceti* we have obtained eleven plates since November 1, 1901, which give a range from + 6 to + 16 km. per sec. The period is short, but observations on consecutive nights will be necessary for its establishment.

The plates of ζ *Tauri* available are ten in number (from November 8, 1901, to December 18, 1902), and give a range from + 7 to + 34 km. The period can not yet be given, but may, perhaps, be about fourteen days. The spectrum is rather unique in respect to its very sharp and strong γ and β lines of hydrogen, with the other lines (some of them metallic) very faint.

One plate of ν *Eridani* was obtained in the autumn of 1901, and four a year later. The range of velocity so far observed is from $+3$ to $+26$ km. per sec.

We regard two or three other stars with spectra of the *Orion* type as suspicious of variable radial velocities, but the number of plates so far obtained is insufficient to establish the variation. The proportion of spectroscopic binaries, found by us in this special class of stars, to the number of which we have obtained three plates is about 1:5.

The Orbit of the Spectroscopic Binary η Orionis: Walter S. Adams.

The variation in the radial velocity of η *Orionis* was discovered at the Yerkes Observatory in December, 1901, by Professor E. B. Frost and the writer. Since that time twenty-eight spectrograms have been secured, covering an interval of very nearly a year, and in the present paper the star's orbit is computed from them by the method of Lehmann-Filliés. The greatest range found is about 285 km., and is the largest which has hitherto been discovered among binaries which like this have one component dark. The spectrum is of the *Orion* type, but contains several silicon, oxygen and nitrogen lines as well.

The period used in plotting the observations is 7.9896 days, and the following elements are found:

$$
\begin{aligned}
\text{Velocity of system } V &= +35.5 \text{ km.}\\
u_2 &= 90° \, 41'.6\\
w &= 42° \, 16'\\
e &= 0.016\\
\mu &= 45°.059\\
T &= 1901, \text{ December } 1.821\\
a \sin i &= 15{,}901{,}000 \text{ km.}
\end{aligned}
$$

An ephemeris is computed with these elements, and the greatest difference between the observed and computed velocities is found to be less than 3 km.

The Masses in 85 Pegasi: George C. Comstock.

85 Pegasi is a sixth magnitude star with an eleventh magnitude companion distant less than a second of arc. Burnham, who discovered the pair in 1878, has published an orbit with a periodic time of 25.7 years. The bright star of the pair has been frequently compared with a neighboring ninth magnitude star, and from a discussion of these measures covering a period of fifty years I find for the masses of the sixth and twelfth magnitude stars the ratio, 2:3, the faint star having the greater mass, although its light is only a hundredth part that of the brighter star.

This result is directly opposed to the common view that regards the fainter component of a binary star as more nearly extinct than its companion, because a smaller mass has caused it to traverse more rapidly the stages of development that lead to extinction.

Stellar Revolutions within the Galaxy: Frank W. Very.

Independent estimates of the parallax of *Nova Persei* give

$$\pi = 0''.052, \quad \text{and} \quad \pi = 0''.049,$$

whence it is concluded that the distance of this presumably galactic object is about 600,000,000,000,000 km. It is proposed to adopt this distance as a first approximation to the sun's distance from the Milky Way.

The first-type stars, of which the galactic stream is mainly composed, probably have rather small linear velocities, and are the result of agglomerative tendencies; but around the central condensations there is a great sphere of stars, mostly in advanced stages of development, which seems to have been produced by stellar dispersal. These outlying stars may have been thrown off from the central condensations by explosions of great magnitude; and if the ve-

locity of recession is not too great, these stars thenceforth revolve around controlling centers, consisting of densely clustering stars, in periods embracing many millions of years.

The attraction of a spherical mass of stars, equivalent to 10,000,000 such suns as ours, the aggregate extending to ten times the assumed solar distance from the Galaxy, is sufficient to produce the present solar velocity (20 km. per sec.) in moving from rest at the outer limit, and to give an oscillation from one extreme to the opposite boundary in a little over 40,000,000 years. With a central galactic condensation sufficient to turn the movement into an eccentric orbital revolution, if apogalacteum is ten times as far away and perigalacteum one tenth as far from the center of motion as the assumed galactic distance, the period of revolution will be shortened, but can not be less than about 6,000,000 years for a circular orbit around a central cluster. The general stellar sphere controls the movement in an elongated orbit at the greater distances, but the massive central agglomerations exercise directive power at the closer approach.

There are certainly more than 10,000,000 stars. Hence, either their attractions are largely mutually annulled through symmetrical external position, or else most of the stars have masses very much less than that of the sun, which must be above the average mass.

As the true proper motions of the stars show little preference for particular directions, the dispersals have occurred indiscriminately in all directions.

The diverse regions of space traversed by the sun in its progression from perigalacteum to apogalacteum may have very different meteoric contents whose reception produces secular changes in the planetary atmospheres, and may influence the development of living forms indirectly.

The apex of the sun's way is now about 20° from the axis of the galactic stream. At perigalacteum the apex will recede to the galactic pole, and the direction of motion of the apex in the interim will determine the axis of the solar orbit.

Preliminary Announcement with regard to the Proper Motions of Certain Faint Stars: GEORGE C. COMSTOCK.

The author has measured micrometrically the positions of 45 faint stars (ninth to twelfth magnitudes) referred to brighter neighboring stars whose proper motions were accurately known. From a comparison of these observations with older data of a similar kind, principally the measurements made by the Struves, he has derived proper motions of the faint stars, which in respect of precision are quite comparable with the proper motions of the fainter fundamental stars, *e. g.*, those of the fifth and sixth magnitudes.

These proper motions, although relatively few in number, furnish a determination of the sun's motion in space entirely independent of all previous data, and based upon stars whose average distance from the solar system is much greater than any hitherto employed. The resulting solar motion is in substantial agreement with previous determinations, and when combined with spectroscopic determinations of the velocity of the sun's motion it furnishes as the mean parallax of the stars observed (magnitude 10.5) the value 0″.005 (40,000,000 radii of the earth's orbit) which is in substantial accord with the extrapolated value furnished by Kapteyn's researches upon the brighter stars.

Other results of the present investigation are: (1) That the proper motions of the fainter half of this list of stars do not seem to be materially less than those of the brighter half, *i. e.*, the eleventh and twelfth magnitude stars are not more distant than

those of the ninth and tenth magnitudes; (2) that the average linear velocity with which these faint stars move through space is of the same order of magnitude as that of the brighter stars and about fifty per cent. greater than the velocity of the sun.

An Inquiry into the Cause of the Nebulosity around Nova Persei: Frank W. Very.

Lockyer's hypothesis of colliding meteor swarms would require spherical swarms of enormous dimensions, and in other respects it does not fit the facts. Radiation hypotheses do not explain the duplicity, or possible triplicity, of the nebulous ring, nor the double ratio of the radii of the two principal rings; neither is the retardation of the expansion satisfactorily accounted for. Reflection hypotheses are absolutely barred, because they demand an impossible albedo in the nebula.

The supposition that the motion is a real one involves the further hypotheses that it is due to particles of corpuscular dimensions, expelled from great masses of intensely heated gas, surrounding the nova, in moments of powerful electric oscillatory discharges; that these discharges assist to ionize the material and start a series of instantaneous magneto-electric impulses which guide the moving particles along lines of magnetic force; that the material is probably diamagnetic and will finally come to rest in loci of least magnetic potential; that the velocity imparted depends on the masses of the ions which appear to be in the ratio 1:2:4; that the velocity is accelerated out to a radius at which magnetic repulsion and gravitational attraction are equal for particles of the given dimensions, and that at greater distances the velocity is retarded. An estimate of the mass and diameter of the nova indicates that, at the surface of the star, the ratio of magnetic force to gravity may be as great as 100,000 to 1 for these minute particles; and as such a force would be capable of generating in a corpuscle a velocity of 100,000 km. per sec. in one second, if it were possible fully to utilize it for this purpose, the only objection which can be urged against the hypothesis is the difficulty of imagining a process by which this force can be economically applied.

In favor of the hypothesis it can be stated that the theoretical variation in the rate of expansion of the nebula has been observed; that the observed motions of nebulous forms agree well with those to be expected if the phenomenon is a species of magnetic phantom; that there are curved and diverging streamers on the south-southwest side, resembling the sheaves of diverging coronal filaments about the sun's poles; that the absence of a corresponding sheaf on the north-northeast side may be explained on Doppler's principle; that the disappearances of certain forms in the outer of the two principal rings after reaching a radius of 14′ to 16′, and the phenomenal and sudden appearance of bright forms at about the same positions, are to be explained on the same principle; that such appearances and disappearances are demanded on the magnetic hypothesis, and are extraordinary anomalies on any other.

It is concluded, therefore, that the nebula resembles a gigantic corona; that its axis is inclined 40° to the line of sight on the south-southwest side; and that the expansion of the nebula is approaching its limit.

The Mounting of Fixed Meridian Instruments: G. W. Hough.

The variation in level and azimuth in fixed meridian instruments is due to the effect of temperature: (1) On the metal outside the piers, (2) on the metal in the piers, (3) on the supporting piers, and (4)

to the motion of the base of the pier. In order to understand how the temperature acts on meridian instruments, we need some physical constants. If we assume the conductivity of iron as one, or unity, mercury is 1/10, stone, brick and wood 1/130 to 1/180. It will be readily understood that the iron outside of the pier will act quickly as a thermometer, the iron inside the pier will act more slowly, and the supporting piers will act very slowly in taking the temperature of the external air.

The piers acting as a thermometer may lag one month or more, and this is the explanation of the phenomenon observed at Edinburgh. Hence we conclude that variation of level and azimuth during a night of observation is almost entirely due to the effect of temperature on the metal parts of the instrument. The covering of piers with cloth and wood is of no use.

Many instruments in use change their level and azimuth by jumps, and not in any regular manner. If the expansion of iron is taken as unity, brass is 2, sandstone and granite 0.8 to 0.9, and bricks from 0.3 to 0.5. It is readily seen that the difference of expansion between brick and iron is so great that the instrument will always be loose on the piers. Hence it is free to jump in both level and azimuth.

In the Pistor & Martin's meridian circle the brass cylinder for holding the Y should be replaced with iron.

The modern Repsold is defective in its mechanical construction, for the reason that the Y-piece and the counterpoise weight are all supported on one frame, and when the instrument is reversed it is liable to be disturbed in level and azimuth. The Dearborn Observatory old pattern Repsold meridian circle is mounted on sandstone piers, and the lugs for holding the Y-pieces are set in with lead. The instrument is absolutely stable in level and in azimuth. The computed monthly level for two years, when corrected for temperature and the motion of the pier, agrees with the observed level within a fraction of a second of arc.

The Probable Value of the Constant of Aberration: S. C. CHANDLER.

The number of determinations of this constant is now so considerable that even wide differences of judgment as to the weights to be assigned them can have but little influence on the mean result. Forty-three determinations are combined with the following weights:

Talcott's method............	20.523	Weight, 151
Meridian declinations	.514	22
Prime vertical transits......	.525	24
Right ascensions............	.53	6
Prismatic apparatus.........	.48	5
Mean	20.521	208

The Constant of Aberration from Observations with the Zenith Telescope, 1901–1902: C. L. DOOLITTLE.

A preliminary reduction of the series of zenith telescope observations covering the period from October 1, 1901, to October 1, 1902, gives for this constant the value 20″.510.

This is preliminary in the sense that some of the work of reduction has not been fully verified and that it is proposed to include in deriving the final result some additional data, viz., about four hundred observations between October 1, 1902, and January 1, 1903.

The values derived from the different series of observations at the Sayre and Flower Observatories are as follows:

(1)	1889–1890	20″.448 ± 014	Weight ¼
(2)	1892–1893	20.551 ± 009	1
(3)	1894–1895	20.537 ± 014	1
(4)	1896–1898	20.580 ± 008	½
(5)	1898–1899	20.540 ± 010	1
(6)	1900–1901	20.561 ± 008	1
(7)	1901–1902	20.510	1
Weighted mean.................			20″.539
Unweighted mean...............			20 .532

I have elsewhere given reasons for suspecting the genuineness of result (1). There are also reasons for the small weight assigned to result (4) aside from the somewhat larger value given.

It is proposed to continue this series for another year. It will then be terminated unless means can be had for giving the investigation a wider scope. For a number of years I have been hoping that I might be able to set up an instrument of different construction and have a second series of observations carried on simultaneously with my own for a period of at least two or three years. At present the necessary means are not available, but I have not entirely abandoned this project.

Micrometrical Measures of Individual Stars in the Great Globular Clusters: E. E. Barnard.

The great power of the forty-inch refractor of the Yerkes Observatory has been utilized in a systematic micrometrical survey of between 600 and 700 small stars in the globular clusters *M* 3, *M* 5, *M* 13 and *M* 92.

The paper deals mainly with the measures of stars in *M* 13 *Herculis* and a comparison of these with measures made by Dr. Schriner, of Potsdam, in 1891, of photographs of the cluster. This comparison shows a generally close agreement between the photographic and visual measures. There are a few discordances amounting to one or more seconds of arc. There does not seem to be any proof that these are due to motion in these stars, but rather due to the difficulty of making the photographic measures. In the ten years' interval there does not appear to be any certain proof of motion in any of the stars under observation. In the work with the large telescope the stars are referred to a standard star in each cluster. This star is accurately measured with reference to known stars, and its absolute position given, from which the exact place of any one of the small stars observed can be easily deduced. The measures were made by the method of position angle and double distances, though the relative position of the stars to the standard stars are given in the order of $\Delta\alpha$ and $\Delta\delta$.

On Some of the Variable Stars in the Cluster M 5, Libræ: E. E. Barnard.

These are observations of some of the variable stars discovered in this cluster by Professor S. I. Bailey.

The smaller stars all have periods of nearly half a day, but there are three bright stars—the brightest in the cluster—which have relatively long periods. These periods are:

Star No.	Period, Days.	Light Range.
42	25.7739	1¾ m.
84	26.5760	1¾ m.
50	106.17	1 m.

The first two rise rapidly to maximum and decline slowly to minimum. No. 50, which seems to have the longest period in the cluster, differs markedly from the other two in that its rise and decline are both slow and uniform. All three are slightly yellowish at maximum.

Several of the small, quick-period variables were under observation. The best observed of these was No. 33, whose period is $0^d\ 12^h\ 2^m\ 7^s.6$, and whose light range is about one magnitude ($1^m.1$). The light curve for this star is rather remarkable.

The normal condition is faint at about 14½ mag. At about one hour before maximum it begins to rise. Its light increases rapidly, and the duration of maximum is very short. The star then declines about as rapidly as it rose, for about forty minutes. It then seems to halt in the decline, and from this on sinks very slowly to minimum, not reaching its faintest or normal condition until seven or eight hours after maximum.

Notes on the Short Method of Determining Orbits from Three Observations: A. O. LEUSCHNER.

In order further to simplify the computation of preliminary orbits, the author proposes several modifications in the application of his 'Short Method, etc.' (*Publications L. O.*, Vol. VII., part 1):

1. The accuracy of ρ_0 is increased by eliminating the parallax from the second observation through simple corrections applied to the corresponding solar coordinates in group I.

2. When the parallax factors for the three observations differ materially, the accuracy of the geocentric velocities is increased by applying the parallax corresponding to the unit of distance to all three observations in the formulæ of group II.

3. No correction for parallax is to be applied to the middle observation on the basis of the successive approximations for ρ_0 (cf. groups V., VII.), but instead the parallax is to be eliminated once for all by correcting the rectangular equatorial solar coordinates for the normal date as follows:

$$\Delta X = (p_a\rho_0)\sin a_0 \cos\delta_0 + (p_\delta\rho_0)\cos a_0 \sin\delta_0,$$
$$\Delta Y = -(p_a\rho_0)\cos a_0 \cos\delta_0 + (p_\delta\rho_0)\sin a_0 \sin\delta_0,$$
$$\Delta Z = -(p_\delta\rho_0)\cos\delta_0.$$

4. By replacing the A and B by

$$A' = A + \cos\delta\, p_a/\rho^2, \qquad B' = B + p_\delta/\rho^2.$$

respectively, in the differential formulæ (group VII.), terms depending on the parallax factors are introduced which will minimize the effect, on the residuals, of changes in parallax, and the convergence is increased.

5. The sufficiency of the differential formulæ should be tested by checking the new residuals obtained in group VII. by means of the corresponding formulæ of group VI.

6. Simple formulæ involving the squares of the corrections have been derived for those rare cases in which the linear relations are found to be insufficient.

7. The new values of x_0, y_0, z_0 (group VII.) may be found rigidly in *all* cases by changing the former values by

$$\partial x_0 = \cos a_0 \cos\delta_0 \partial\rho_0, \quad \partial y_0 = \sin a_0 \cos\delta_0 \partial\rho_0,$$
$$\partial z_0 = \sin\delta_0 \partial\rho_0.$$

8. The method may be applied to longer arcs by using closed expressions in place of the series in group VI.

A Method of Computing Orbits in Rectangular Coordinates: A. O. LEUSCHNER.

From

$$\omega_a = f_a\omega_0 + g_a\omega_0 \quad (\omega = x, y, z)$$

(*Publications L. O.*, Vol. VII., part 1) the author derives the three fundamental equations:

$$\omega_0 = \frac{g_{111}}{f_1 g_{111} - f_{111} g_1}\omega_1 - \frac{g_1}{f_1 g_{111} - f_{111} g_1}\omega_{111}.$$

Introducing

$$\rho\cos a\cos\delta = x + (X)$$

in the first of these three equations, it becomes

$$\frac{g_{111}}{f_1 g_{111} - f_{111} g_1}\rho_1 \cos a_1 \cos\delta_1$$
$$-\frac{g_1}{f_1 g_{111} - f_{111} g_1}\rho_{111}\cos a_{111}\cos\delta_{111} - \rho_0 \cos a_0 \cos\delta_0$$
$$+ (X)_0 - g_{111}(X)_1 + g_1(X)_{111} = 0$$

where the (X) (similarly the (Y) and (Z) in the remaining two equations) are the solar coordinates, corrected, to eliminate parallax, by the formulæ given in 3 of the foregoing 'Notes.' These coordinates are referred to the beginning of the year and apply to the actually observed dates.

The solution of the fundamental equations gives at once

$$\rho_0 = \frac{c_x D' + c_y D'' + c_z D'''}{D}$$

where the D are simple functions of the uncorrected observations, and

$$c_x = (X)_0 - \frac{g_{111}}{f_1 g_{111} - f_{111} g_1}(X)_1 + \frac{g_1}{f_1 g_{111} - f_{111} g_1}(X)_{111}$$

or otherwise

$$c_x = (X)_0 - \frac{[r_{11} r_{111}]}{[r_1 r_{111}]}(X)_1 - \frac{[r_1 r_{11}]}{[r_1 r_{111}]}(X)_{111}$$

and where c_y, c_z are given by similar expressions. If not previously available, a first approximation to the triangular ratios may be obtained by the 'Short Method, etc.' Next ρ_1, ρ_{111}, x_0', y_0' and z_0' are obtained by simple expressions. The accuracy of the initial values of the ratios of the triangles is now tested by recomputing them from closed expressions or by the series. Any disagreement between the initial and final values is removed by means of differential formulæ. The elements are computed by formulæ VIII. of the 'Short Method.' The use of rectangular coordinates as outlined in the paper presents many advantages and is applicable to long arcs.

The Solution of an Orbit, Irrespective of Parallax and Aberration: A. O. LEUSCHNER.

In the 'Method of Computing Orbits in Rectangular Coordinates' the effects of parallax and aberration are fully eliminated, except in the expressions for the ratios of the triangles, in which the θ's are affected by the difference of planetary aberration ($e. g.$, $\theta_{11} = k(t_{111} - t_1)$). In certain rare cases, particularly for very short intervals, the c_x, c_y, c_z become so small that the solution will become indeterminate unless the accurate differences in planetary aberration can be introduced at the start. In a first orbit, therefore, recourse is had to eliminating the first powers of the differences in aberration, by segregating the first powers of the θ's as factors from c_x, c_y, c_z and then replacing them by expressions involving the differences of aberration, *e. g.*,

$$\theta_1 = \theta_1^0 - ka(\rho_{111} - \rho_1).$$

The fundamental equations then take the form

$$a\rho_1 + b\rho_0 + c\rho_{111} + d + kae\rho_{111}\rho_1 + kaf\rho_{111}\rho_0 + kag\rho_0\rho_1 = 0,$$

where a is the aberration factor.

The solution of these equations is reduced to the solution of two equations of the form

$$\rho_0 = f(\rho_{111} - \rho_1) \quad \text{and} \quad \rho_{111} - \rho_1 = \phi(\rho_0)$$

from which $(\rho_{111} - \rho_1)$ and ρ_0 are obtained.

The Orbit of Comet 1902 a: A. O. LEUSCHNER.

The paper contains a preliminary report on the investigation of the orbit of comet 1902 *a*. A preliminary orbit based on three observations, of which the third represented a single micrometric measure in α and δ was published shortly after the appearance of the comet. The elements, which were computed by the 'Short Method,' indicated an unusually short period. A comparison of the sum of the squares of the residuals from the elliptic with those from a parabolic orbit computed at Kiel gave the following results for the first nine observations;

[vv]	parabolic orbit	2985
[vv]	elliptic orbit	711

For further investigation the observations were grouped into six places, three of which represent single observations, one was based on two, one on three, and one on five observations. The best three of these were selected for the improvement of both the parabolic and elliptic orbits. The final parabolic orbit is completed and does not represent the

observations so well as the preliminary elliptic orbit. In determining the final elliptic orbit many difficulties were encountered which led to the theoretical results given in the foregoing papers. The calculation of an orbit irrespective of parallax and aberration has just been undertaken. A preliminary improvement of the orbit gave evidence that the first results concerning a very short period will be substantiated. The following students and assistants have taken part in the computations: Dr. R. T. Crawford; Messrs. H. K. Palmer, Joel Stebbins, Ralph Curtiss, C. A. G. Weymouth, Fellows in the Lick Observatory; and Miss A. M. Hobe.

The Photoheliograph of the U. S. Naval Observatory; Its Use and Defects in Solar Photography: G. H. PETERS.

This paper dealt with the changes made in the instrument during the past four years. A considerable variation of focal length has been found, amounting to about one half inch, between the temperature of summer and winter. In a proposed new and larger instrument, some defects due to the attached building are to be avoided.

The use of Jena glass No. 0.2164 combined with No. 0.2001, with an alternative of No. 0.164, is suggested for this lens, to reduce the secondary spectrum to a minimum.

Attention was called to the necessity of a study of the thermo-focal changes in long focus lenses, to be used in eclipse work.

Results of Meridian Observations for Stellar Parallax made at the Washburn Observatory, University of Wisconsin: ALBERT S. FLINT.

Results were presented for a list of ninety-six stars whose distances from the solar system were to be determined. This list consists mainly of stars whose proper motion, or drift across the heavens, is comparatively large; and these results show that, on the average, the larger this apparent motion, the nearer the star. These observations were forwarded to Professor Kapteyn, of Groningen, Holland, who made use of them in an important investigation of the structure of the heavens.

Preliminary Statement of the Magnetic Disturbances Coincident with the Recent Eruption in Martinique: L. A. BAUER.

The disturbances of the magnetic needle coincident with the volcanic eruption of May 8 and 20 were felt practically simultaneously at the four Coast and Geodetic Survey magnetic observatories situated respectively at Cheltenham (Maryland), Baldwin (Kansas), Sitka (Alaska) and Honolulu (Hawaiian Islands).

In response to a circular sent by the Superintendent of the Coast and Geodetic Survey records have been received from the principal foreign observatories. A cursory examination of these records shows the disturbances and that they occurred practically simultaneously at all of the observatories thus far heard from. An examination of the records indicates that apparently there were premonitory symptoms a month before the actual outbreak. The records will be subjected to a critical discussion, with the view of settling definitely whether the cause of these remarkable disturbances had its source within or outside of the earth's crust.

A comparison of these effects was made with that which had revealed itself during the total solar eclipse of May 28, 1900, and also the more recent one of May 18, 1901. It was shown that the eclipse effect is not in any sense to be classed as a magnetic disturbance, but that it is of the periodic variation kind and is precisely similar in character to the solar diurnal variation.

Preliminary Note on the Total Light of the Stars: Sidney D. Townley.

While engaged in photometric work at the Lick Observatory during the past summer a few experiments were made to determine the amount of light received from the sky at night when the moon is not shining. This work was undertaken at the request of Director Campbell, to whom the problem was suggested by Professor Newcomb.

Both visual and photographic methods are applicable to the solution of this problem, and Professor Newcomb has already employed some of the visual methods, the results of which were printed in the *Astrophysical Journal*, December, 1901. My efforts were directed almost exclusively to perfecting a photographic method. The results thus far obtained are meager, but it is believed that a reliable method has been found.

The method adopted is, indeed, very simple. Both lenses were removed from the Crocker photographic telescope and a cardboard cap of three centimeters diameter attached to the end of the telescope tube. An exposure of one hour was made upon a bright star and the result was, of course, an impression on the plate of the size and shape of the aperture. Exposures were then made upon the sky by means of four camera boxes, consisting simply of aperture and plate, attached to a polar axis made of a piece of 4 x 4. The angular apertures used varied from five to ten degrees. The five plates were developed at the same time in a large tray, and their relative intensities measured by means of a Lummer-Brodhun photometer.

In the very limited length of time which I had to devote to this work it was possible to obtain only a few sets of plates. Two of these sets give reliable results. In each Vega was the comparison star used. In the one the camera boxes were directed to the sky about half way between γ *Pegasi* and β *Ceti,* in the other to the Milky Way nearest Vega.

The results are, from the first, that the light of Vega is equivalent in actinic intensity to the light received from an area of rather vacant non-galactic sky 7° 16′.4 in diameter, from the second, that the light of Vega is equivalent to the light received from an area of galactic sky 5° 19′.8 in diameter. This gives galactic sky to be 1.9 times brighter than non-galactic sky. If we take the magnitude of Vega to be 0.2, then from the first result we find that the light received from an area of non-galactic sky one degree in diameter is equal to the light of a 4.5 magnitude star, which is not far from the result obtained by Professor Newcomb, namely, that the light received from an area of non-galactic sky one degree in diameter is equal to 0.9 the light of 5.0 magnitude star.

Photometric and Photographic Observations of Faint Variable Stars: J. A. Parkhurst.

In the course of this work at the Yerkes Observatory several stars have been found whose brightness at minimum is at or below the limit of the 40-inch refractor. To illustrate three specimen fields, lantern slides were prepared from negatives taken with the 24-inch reflector, covering a field of 30′ around the variable, corresponding to the inner square of Hagen's charts.

7220 S Cygni.—Plate taken November 24, 1902, exposure 61 minutes. The variable is about 11th magnitude; its greatest range of variation is from the 8th to the 16th magnitude, being approximately equal at maximum to the star 1′ north, and at minimum to the star 0′.5 preceding.

7458 V Delphini.—Plate taken September 7, 1902, exposure 68 minutes. This star has perhaps the greatest range of any

known variable. At the maximum of 1899 it reached nearly the 7th magnitude, at minimum it is about the 17th magnitude. As shown on the slide it is 10th magnitude, at its faintest it is equal to the small star 0′.2 south.

7582 X Cephei.—Plate taken March 13, 1902, when the variable was photographically fainter than 17th magnitude, and visually below the limit of the 40-inch when using the eyepiece of the photometer, power 237. The magnitude at maximum is 9.7, equal to the star 4′ south, 1′ following.

The work in progress includes determination of the photometric magnitudes of comparison stars for 25 faint variables, using the equalizing wedge photometer devised by Professor E. C. Pickering, in connection with telescopes of 6, 12 and 40 inches aperture; connecting the comparison stars with Harvard and Potsdam standards in the neighborhood; also visual comparisons by Argelander's method, and photographs of the fields for the purpose of certain identification of the comparison stars, and for determining the brightness of the variable when below the visual limit of the telescopes used.

W. S. Eichelberger,
For the Council.

THE ASSOCIATION OF AMERICAN ANATOMISTS.

The sixteenth session of the Association of American Anatomists, meeting in conjunction with the American Society of Naturalists and other affiliated societies, was held in Washington, D. C., December 30 and 31, 1902. The association met in the Columbian University Medical School.

The association gave consideration, at its general business session, to the following recommendations made by the executive committee:

1. They accepted the invitation tendered by the American Association for the Advancement of Science, to form an affiliation with this association, agreeing to elect a delegate to the council of the American Association for the Advancement of Science. Such affiliation impairs in no degree the integrity of the Association of American Anatomists and does not bind this association to meet with the American Association for the Advancement of Science, unless it deems it expedient.

2. In view of the fact that the regular annual meeting of this association was held this year in Washington, it was deemed inadvisable to arrange for a second meeting at this place in May of the present year, in conjunction with the other American associations and societies participating in the Congress of American Physicians and Surgeons. This association, therefore, moved that the meeting in connection with the Congress of American Physicians and Surgeons in May, 1903, be omitted.

3. It was moved to omit from the program the abstracts of papers presented at the meetings.

4. The following addition was made to the by-laws of the association: 'Newly elected members must qualify by payment of dues for one year within thirty days after election.'

5. It was voted that any change in the constitution of this association must be presented in writing at one meeting in order to receive consideration and be acted upon at the next meeting; due notice of the proposed change to be sent to each member at least one month in advance of the meeting at which such action is to be taken.

6. The following amendment to Article V. of the constitution was proposed at this meeting and will receive consideration at the next annual meeting:

"Candidates for membership must be persons engaged in the investigation of

anatomical or cognate sciences, and shall be proposed in writing to the executive committee by two members, who shall accompany the recommendation by a list of the candidate's publications, together with the references.''

7. On motion of Dr. James Playfair McMurrich, it was voted 'that a committee of three be appointed to select topics for cooperative investigation by the members of the association.'

The following officers were elected: Professor Charles S. Minot, Boston, member of the executive committee (five years), to succeed himself; Dr. Joseph A. Blake, New York City, delegate to the executive committee of the Congress of American Physicians and Surgeons, to succeed himself; Professor Simon H. Gage, Cornell University, delegate to the council of the American Association for the Advancement of Science.

Nineteen new members were elected.

The following papers were presented:

DR. ROBERT R. BENSLEY (Hull Laboratory of Anatomy, Chicago): 'On the Histology of the Glands of Brunner.'

DR. ROBERT R. BENSLEY: 'The Histogenetic Differentiation of the Specific Elements of the Gastric Glands of the Pig.'

DR. SIDNEY KLEIN (Hull Laboratory of Anatomy, Chicago): 'On the Nature of the Granule-cells of Paneth in the Intestinal Glands of Mammals.' (Presented by Dr. Robert R. Bensley.)

DR. JOSEPH MARSHALL FLINT (Hearst Anatomical Laboratory, University of California): 'The Development of the Framework of the Submaxillary Gland.'

DR. ROSS G. HARRISON (Anatomical Laboratory, Johns Hopkins University): 'On the Differentiation of Muscular Tissue when Removed from the Influence of the Nervous System.'

DR. WILLIAM S. MILLER (University of Wisconsin): 'The Terminal Arrangement of the Bronchi in the Cat.'

DR. WILLIAM S. MILLER: 'Three Cases of Pancreatic Bladder in the Cat.'

DR. G. CARL HUBER (University of Michigan): 'On the Morphology of the Sudoriparous and Allied Glands.'

DR. WILLIAM KEILLER (Department of Medicine, University of Texas): 'On the Preservation of Subjects for Dissection by Injection with Formalin and Carbolic Acid Solution, and Storage by Immersing in Similar Solutions.'

DR. WILLIAM A. SPITZKA (Department of Anatomy, Columbia University, New York City): 'The Anatomy of the Human Insula in its Relation to the Speech Centers; According to Race and Individuality.'

DR. D. K. SHUTE (Washington, D. C.): 'Sinuses or Air Chambers in Communication with the Nasal Fossæ.'

DR. THOMAS G. LEE (University of Minnesota): 'Notes on the Early Development of Rodents.'

DR. G. S. HOPKINS (Cornell University): 'Notes on the Variation in Origin of the Internal Carotid of the Horse.'

DR. R. H. WHITEHEAD (University of North Carolina, from the Hull Laboratory of Anatomy, Chicago): 'A Study of the Histogenesis of the Adrenal of the Pig.'

DR. GEORGE S. HUNTINGTON (Columbia University, New York City): 'The Derivation and Significance of Certain Supernumerary Muscles of the Pectoral Region.'

DR. JAMES PLAYFAIR MCMURRICH (University of Michigan): 'The Evolution of the Flexor Sublimis Digitorum.'

DR. ALBERT C. EYCLESHYMER (Hull Laboratory of Anatomy, Chicago): 'The Histogenesis of Striated Muscles of *Necturus*.' (Presented by Dr. Lewellys F. Barker.)

DR. LEWELLYS F. BARKER (Hull Laboratory of Anatomy, Chicago): 'On the Relation of the Third Fœtal System of Trepinski in the Dorsal Funiculi to the Nucleus Dorsalis and the Fasciculus Cerebello-spinalis.'

DR. BURT G. WILDER (Cornell University): 'The Mesial Aspect of the Left Hemicerebrum with Selected Humans and Representative other Primates.'

DR. BURT G. WILDER: 'Reasons why Orderly, Educated and Fairly Prosperous Whites should leave their Brains for Scientific Purposes; with Suggestions for Form of Brain Bequest.'

DR. BURT G. WILDER: 'Queries as to the Human Ankle-joint and the Peroneus tertius.'

The following papers were read by title:

DR. GEORGE E. SHAMBAUGH (Hull Laboratory of Anatomy, Chicago): 'The Circulation in the Internal Ear of *Sus scrofa domestica*.'

DR. J. RALPH HARRIS (Washington, D. C.): 'A Comparison of Human and Orang Hearts,' with lantern slides.

DR. DANIEL G. REVELL (Hull Laboratory of Anatomy, Chicago): 'An Anomaly of the Vena Cava Inferior.'

One afternoon was given over to demonstrations. This proved an especially attractive and instructive feature of the meeting.

The following demonstrations were made:

DR. CHARLES R. BARDEEN: (*a*) The effect of fatigue on muscle nuclei (P. K. Tilman); (*b*) nerve and muscle preparations; (*c*) students' charts made during dissection.

DR. ROSS G. HARRISON: (*a*) Specimens illustrating the differentiation of muscular tissue when removed from the influence of the nervous system; (*b*) specimens illustrating the development of the lateral line and wandering of the skin in the amphibian embryo.

DR. G. CARL HUBER: (*a*) Models of sudoriparous and allied glands; (*b*) photograph of a new apparatus for making wax plates for reconstruction after the method of Born.

DR. WILLIAM KEILLER: Specimens illustrating the state of preservation of material injected by formalin and carbolic acid solutions, also wet and dry museum preparations.

DR. HENRY MCE. KNOWER (Secretary of the editorial board of *American Journal of Anatomy*): A demonstration on illustrations for anatomical publications.

DR. WILLIAM S. MILLER: (*a*) Models illustrating the terminal arrangement of the bronchi in the cat; (*b*) specimens illustrating pancreatic bladder in the cat; (*c*) the lymphatics of the lung of *Necturus*.

DR. BURTON D. MEYERS (Anatomical Laboratory, Johns Hopkins University): Specimens illustrating the partial decussation of the optic fibers in the chiasm of some mammals, and the commissures on the floor of the third ventricle.

DR. FLORENCE R. SABIN (Anatomical Laboratory, Johns Hopkins University): Gross and microscopic preparations of developing lymphatics.

DR. EDWARD A. SPITZKA: Drawings and plaster models, illustrating the anatomy of the human insula in its relation to the speech-centers.

DR. MERVIN T. SUDLER (Cornell University): Photographs of the lymphatic system and topographical dissections as made in the anatomical course of the Cornell University Medical College.

DR. ABRAM T. KERR (Cornell University): Corrosion preparations.

G. CARL HUBER,
Secretary.

THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

THE fifteenth annual meeting of the association met in the Natural History Room of the Columbian University, Washington, D. C., Friday and Saturday, December 26 and 27, 1902. The attendance throughout was quite large and the meeting was one of the most successful in the history of the association. The following papers were presented:

W. B. ALWOOD, Blacksburg, Va.: 'Injury by Seventeen-year Locust.'

W. E. BRITTON, New Haven, Conn.: 'The Lime, Sulfur and Salt Wash in Connecticut.'

A. F. BURGESS, Columbus, Ohio: 'Economic Notes on the Coccinellidæ.'

F. H. CHITTENDEN, Washington, D. C.: (1) 'Notes on the Larger Sugar-beet Leaf Beetle, *Monoxia puncticollis* (Say)'; (2) 'Notes on Insects that have Recently been Injurious to Truck Crops.'

E. W. DORAN, Champaign, Ill.: 'Vernacular Names of Insects.'

E. P. FELT, Albany, N. Y.: (1) 'The Literature of American Economic Entomology' (presidential address): (2) 'Observations on the Grapevine Root Worm'; (3) 'Results Obtained with Certain Insecticides; (4) 'Notes on Injurious Insects.'

JAMES FLETCHER, Ottawa, Canada: (1) 'Can the Pea Weevil be Exterminated?' (2) 'Injurious Insects of the Year in Canada.'

V. L. KELLOGG, Stanford University, Cal.: 'Notes on California Coccidæ, Aleurodidæ and Scolytidæ.'

C. L. MARLATT, Washington, D. C.: 'Economic Entomology in Japan, with Notes on Some of the Principal Insect Pests.'

H. A. MORGAN and J. W. DUPREE, Baton Rouge, La.: 'Life Histories and Hibernation of Mosquitoes.'

HERBERT OSBORN, Columbus, Ohio: (1) 'Notes on Ohio Insects for Season of 1902'; (2) 'A

Method for Mounting dry Coccidæ for Permanent Preservation.'

J. L. Phillips, Blacksburg, Va.: 'Notes on *Melanoplus femoratus*.'

A. L. Quaintance, College Park, Md.: (1) 'Further Notes on the Lime, Sulfur and Salt Wash in Maryland'; (2) 'Entomological Notes from Maryland.'

F. Wm. Rane, Durham, N. H.: 'Plant Environment and Insect Depredation.'

C. B. Simpson, Washington, D. C.: 'Observations on the Life History of the Codling Moth.'

J. B. Smith, New Brunswick, N. J.: (1) 'Distribution of Broods of the Periodical Cicada in New Jersey'; (2) 'Notes on Experiments with Mosquito Larvicides'; (3) 'Notes on *Culex sollicitans*, its Habits and Distribution.'

T. B. Symons, College Park, Md.: 'On the Position of the Setæ of the San José Scale in the Tissues of Infested Plants.'

F. L. Washburn, St. Anthony Park, Minn.: (1) 'Distribution of the Chinch Bug in Minnesota'; (2) 'A Criticism Upon Certain Codling Moth Investigations.'

F. M. Webster, Urbana, Ill.: 'A Partial Insect Fauna of *Elymus Canadensis*.'

Clarence M. Weed, Durham, N. H.: 'Notes from New Hampshire.'

The following officers were elected for the ensuing year:

President—Professor M. V. Slingerland, Ithaca, N. Y.

Vice-President—Professor C. M. Weed, Durham, N. H.

Second Vice-President—Dr. Henry Skinner, Philadelphia, Pa.

Secretary and Treasurer—Professor A. F. Burgess, Columbus, Ohio.

A. L. Quaintance,
Secretary.

THE BOTANICAL SOCIETY OF AMERICA.

The Botanical Society of America held its ninth annual meeting at Washington, D. C., December 30, 1902, to January 1, 1903, under the presidency of Dr. B. T. Galloway.

The address of the past president, Dr. J. C. Arthur, 'Problems in the Study of the Plant Rusts,' was given in the medical building, Columbian University, December 31, 1902. This address has been printed in the *Bulletin of the Torrey Botanical Club* for January, and reprinted as publication 22 of the society. The program of scientific papers was presented on December 31, 1902, and January 1, 1903.

L. M. Underwood and M. A. Howe: 'The Distribution of the Genus *Riella*, with Descriptions of New Species from North America and the Canary Islands.'

F. S. Earle: 'Types of the Linnæan Genera of Fungi.'

L. R. Jones: 'Pressure and Flow of Sap in the Sugar Maple.'

B. M. Duggar: 'The Nutrition of Certain Edible Basidiomycetes.' (Illustrated.)

H. de Vries: 'Atavistic Variations in *Onagra cruciata* (Nutt.) Small.' (By invitation.)

J. M. Coulter and C. J. Chamberlain: 'The Embryo of *Zamia*.'

K. Goebel: 'Regeneration in Plants.' (By invitation.)

W. A. Kellerman: 'Uredinous Infection: Suggestions and Experiments.'

F. M. Andrews: 'Contribution to the Physiology of the Cell.' (By invitation.)

W. A. Murrill: 'North American Species of the Genus *Mison*.' (By invitation.)

W. A. Murrill: 'The Genera of Polyporaceæ.' (By invitation.)

J. C. Arthur: 'Cultures of Uredinæ in 1902.'

F. E. Clements: 'Herbaria Illustrating Plant-formations.'

H. C. Cowles: 'The Relative Importance of Edaphic and Climatic Factors in Determining the Vegetation of Mountains, with Especial Reference to Mt. Katahdin.' (Illustrated.)

H. C. Cowles: 'Two Distinct Types of Rivers from the Point of View of Physiographic Ecology.'

D. M. Mottier: '*Podophyllum peltatum* as an Anomalus Dicotyledonous Plant.'

C. MacMillan: 'The Fenestration of *Martensia*.'

D. S. Johnson: 'The Development of the Embryo-sac in the Genera of the Saururaceæ.'

A. D. Selby: 'The Etiolation of Seedlings of *Persea gratissima*.'

Arthur Hollick: 'A Fossil Petal of *Magnolia* from the Dakota Group of Kansas.'

W. J. Gies: 'Alkaverdin, a Hitherto Unknown Pigment Found in Leaves of *Sarracenia purpurea*.' (By invitation.)

W. J. Gies: 'The Digestive Action Ensuing in the Pitchers of *Sarracenia purpurea*.' (By invitation.)

H. N. Whitford: 'Some Studies in Forest Ecology in Northwestern Montana.' (By invitation.)

W. A. Cannon: 'The Cytological Basis of the Mendelian Theory of Hybrids.' (By invitation.)

H. M. Richards: 'The Effect of Wounds on Turgidity.'

R. H. True and W. J. Gies: 'The Physiological Action of Heavy Metals in Mixed Solutions.'

W. J. Beal: 'What is a Bud and How Long May it Survive?'

F. E. Clements: 'The Limits of Ecology.'

G. F. Atkinson: 'The Life-history of *Hypocrea alutacea*.'

B. M. Davis: 'The Origin of the Archegonium.'

E. C. Jeffrey: 'Studies on the Cyperaceæ.'

F. S. Earle: 'Systematic Relations of the Genera of the Agaricaceæ.'

A. M. Vail: 'A New Species of *Vincetoxicum* from Alabama.' (By invitation.)

A. M. Vail: 'Notes on the Genus *Rouliniella*.' (By invitation.)

D. T. MacDougal: 'Growth as Affected by Light and Darkness.'

D. T. MacDougal: 'Effect of Etiolation on the Cortex and Periderm of Trees.'

D. T. MacDougal and W. A. Cannon: 'Aerial Propagative Roots of *Globba*.'

B. C. Gruenberg and W. J. Gies: 'Chemical Studies of Trade Varieties of Logwood.' (By invitation.)

N. L. Britton: 'Recent Botanical Explorations in Bolivia.'

A. S. Hitchcock: 'Type Specimens of North American Species of *Agrostis*.'

The following associates were elected members: Dr. Charles Joseph Chamberlain, University of Chicago, Chicago, Ill.; Dr. Alexander William Evans, Yale University, New Haven, Conn.; Dr. Duncan Starr Johnson, Johns Hopkins University, Baltimore, Md.

The society now consists of 39 members, 16 associates and 1 patron.

The treasurer's report showed the total assets of the society to be $3,240, and grants were made as below:

To Dr. Arthur Hollick, $150, to be used in the prosecution of a study of the fossil flora of the Atlantic coastal plain.

To Dr. J. C. Arthur, $90, to be used in defraying expenses extending his researches upon the plant rusts.

To Dr. D. S. Johnson, $200, to enable him to extend the study of the endosperm and seed in the Piperaceæ and Chloranthaceæ, by means of material to be collected in Central America and the West Indies.

The officers for the ensuing year are:

President—Charles Reid Barnes, University of Chicago, Chicago, Ill.

Vice-President—Joseph Nelson Rose, U. S. National Museum, Washington, D. C.

Treasurer—Arthur Hollick, New York Botanical Garden, New York City.

Secretary—Daniel Trembly MacDougal, New York Botanical Garden, New York City.

Councilors—William Trelease, Missouri Botanical Garden, and Benjamin Lincoln Robinson, Gray Herbarium, Harvard University, Cambridge, Mass.

The above officers, with past president B. T. Galloway, constitute the Council of the Society.

Arthur Hollick and H. M. Richards were chosen to represent the society in the council of the American Association for the Advancement of Science.

This meeting was a most notable one in the history of the society, in the matter of attendance of the members, the number and character of papers presented and in the showing of the general financial strength of the organization. The award of grants as above, constituted the first series given under the newly declared policy of the society.

D. T. MacDougal,
Secretary.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

ELECTION OF FELLOWS.

The following members were elected fellows at the sessions of the Council on December 31, 1902, and January 1, 1903:

Adams, C. C.

Adler, Isaac P., Physician.

Allen, Frank, Assistant in Physics, Cornell University.

Ashley, George H., Professor of Biology and Geology, College of Charleston.

Austin, Oscar Phelps, Statistician.

Bagg, R. M., Ph.D., Science Teacher in High School.

Baker, James H., President, University of Colorado.

Balch, E. S., Geographer.

Ball, Elmer D., Professor of Animal Biology, Utah College.

Barnhart, John H., Bibliographer.

Bergey, David H., Bacteriology and Hygiene, Assistant in Hygienic Laboratory.

Bigelow, Maurice A., Instructor in Biology, Teachers College, N. Y.

Bigelow, Robt. P., Boston, Mass.

Brackon, Henry M., Physician.

Brown, S. J., Professor Mathematics, U. S. Naval Academy.

Browning, Philip Embury, Assistant Professor of Chemistry, Yale University.

Calvert, P. P., Instructor in Zoology, University of Pennsylvania.

Campbell, Marius R., U. S. Geologist, Washington, D. C.

Carroll, James, M.D., Surgeon, U.S.A.

Chaille, Stanford E., Physician.

Clements, Julius Morgan, Assistant Professor of Geology, University of Wisconsin.

Cohen, Solomon Solis, M.D., Professor and Investigator in Scientific Medical Subjects.

Cook, Samuel R., Instructor in Physics, Case School Applied Science.

Coplin, W. M. L., M.D., Professor of Pathology and Bacteriology.

Cowles, Edward, M.D., Alienist.

Cox, John, Professor of Physics, McGill University, Montreal, Canada.

Crampton, H. E., Adjunct Professor of Zoology.

Crile, George W., M.D., Surgeon and Investigator.

Crook, Alja Robinson, Professor of Mineralogy and Economic Geology, 725 Emerson St., Evanston, Ill.

Curtis, C. C., Instructor in Botany, Columbia University.

Curtis, W. E., Journalist and Author.

Davis, Nathan Smith, M.D., LL.D.

Davis, W. H., Assistant in Psychology, Columbia University.

Davy, J. Burtt, Instructor in Botany, University of California.

Dawson, Percy M., M.D., Associate in Physiology.

Diller, J. S., U. S. Geologist, Washington, D. C.

Dock, George, Professor of Medicine, University of Michigan.

Dryer, Charles R., Professor of Geography, High School, Terre Haute, Ind.

Dunham, Edward K., M.D., Professor of Pathology, Carnegie Laboratory, New York.

Eiesland, John, Professor of Mathematics, Thiel College, Greenville, Pa.

Evans, A. W., Physician.

Focke, Theodore M., Ph.D., Assistant Professor of Mathematics, Cleveland, Ohio.

Fuller, George W., Consultant in Sanitary Matters.

Girty, George H., Paleontologist, United States Geological Survey, Washington, D. C.

Glenn, L. C., Professor of Geology, Vanderbilt University, Nashville, Tenn.

Green, Bernhard R., Superintendent of Congressional Library Building.

Griffiths, David, Agrostologist Assistant.

Hague, James D., Geologist and Mining Engineer.

Halsted, William S., M.D., Professor of Surgery, Johns Hopkins.

Hatcher, J. B., Curator, Carnegie Museum, Pittsburgh, Vertebrate Paleontology.

Haupt, Lewis M., Consulting Engineer.

Hayes, Charles Willard, U. S. Geologist, Washington, D. C.

Hillebrand, W. F., Assistant Chemist, U. S. Geological Survey.

Hiss, P. Hanson, M.D., Instructor in Pathology and Bacteriology.

Hough, Theodore, Assistant Professor of Biology, Boston.

Howe, Marshall Avery, Assistant Curator, New York Botanical Garden.

Hull, Gordon F., Ph.D., Assistant Professor of Physics, Dartmouth College, Hanover, N. H.

Irving, John D., U. S. Geologist, Washington, D. C.

Jenney, Walter P., Mining Engineer and Consulting Geologist.

Keasbey, L. M., Professor of Economics and Politics, Bryn Mawr.

Kinsley, Carl.

Kinyoun, J. J., M.D., Bacteriologist in Milford Laboratories.

Landes, Henry, State Geologist, Seattle, Wash.

Larkin, Edgar L., Director, Lowe Observatory.

LeBaron, J. Francis, Civil Engineer.

Lee, W. T., Professor of Geology in College, Trinidad, Colorado.

Littell, Frank B., Professor of Mathematics, U. S. Naval Observatory.

Lyman, Benjamin Smith, Geologist and Mining Engineer.

McKenney, R. E. B., A.M., M.S., Ph.D., Expert in Veg. Phys. and Path., Department of Agriculture; Assistant Professor of Botany, Columbian University.

McLennan, John C., Associate Professor of Physics, University of Toronto, Toronto, Canada.

Martin, G. C., Assistant Geologist, Maryland Geological Survey.

Mead, Elwood, Chief of Irrigation Investigations.

Mendenhall, W. C., U. S. Geologist, Washington, D. C.

Miyake, Kuchi, Investigator.

Moenkhaus, W. J., Teacher and Investigator of Zoology, Bloomington, Indiana.

Moore, Eliakim H., Head Professor of Mathematics, University of Chicago.

Moore, P. M., Geologist and Mining Engineer, St. Louis, Mo.

Nelson, Aven, Professor of Biology, University of Wyoming.

Newsom, J. F., Stanford University.

Olive, Edgar W., Instructor in Botany, Harvard University.

Ortmann, A. E., Curator Invert. Pal. Museum, Princeton University.

Park, William H., M.D., Bacteriologist, New York Department of Health.

Parker, Edward W., Statistician, U. S. Geological Survey.

Perrine, C. D., Astronomer, Lick Observatory.

Pond, C. G., Professor of Chemistry, State College, Pa.

Putnam, Mrs. M. L. D., President of Davenport (Ia.) Academy.

Quaintance, A. L., State Entomologist, College Park, Md.

Ransome, Frederick Leslie, U. S. Geologist, Washington, D. C.

Rhodes, Edward, Instructor in Physics, Haverford, Penn.

Richardson, Miss Harriet, Connected with Smithsonian Institution.

Richardson, Mark Wyman, M.D., Engaged chiefly in laboratory work in clinical medicine, Boston, Mass.

Sachs, B., M.D., Clinical Neurologist, New York.

Schuchert, Charles, Paleontologist, U. S. National Museum, Washington, D. C.

Smallwood, W. M., Ph.D., Associate Professor of Zoology, Syracuse, N. Y.

Strong, Oliver S., Biologist and Neurologist, Columbia University, New York.

Thayer, William S., Associate Professor of Medicine, Johns Hopkins University.

Tyrrell, J. B., Mining Engineer.

Tyson, Dr. James, Professor of Medicine.

Weed, W. H., U. S. Geologist, Washington, D. C.

Wheeler, Alvin Savage, Ph.D., Associate Professor of Organic Chemistry, University of North Carolina, Chapel Hill, N. C.

Williston, Dr. Samuel W., Paleontology.

Winslow, Charles E. A., Instructor in Biology.

Witmer, Dr. L., Assistant Professor of Psychology, University of Pennsylvania.

Woods, Dr. James Houghton, Instructor, Harvard University.

Wyeth, Dr. John A., Surgeon.

Wyman, Dr. Walter, Surgeon-General, Marine Hospital Service.

SCIENTIFIC BOOKS.

Quantitative Classification of Igneous Rocks, based on chemical and mineral characters with a Systematic Nomenclature. By WHITMAN CROSS, JOSEPH P. IDDINGS, LOUIS V. PIRSSON and HENRY S. WASHINGTON; with an introductory review of the development of Systematic Petrography in the nineteenth century, by WHITMAN CROSS. The University of Chicago Press. 1903. Pp. 286.

During the past year there have appeared in the *Journal of Geology* a series of papers dealing with the various aspects of petrographical classification. These, which really form parts of a continuous treatise, have been gathered together in the present volume. A series of tables and a glossary have been added, the whole forming one of the most valuable contributions to systematic petrography which has as yet appeared.

Few sciences have shown a more rapid development than the science of petrography. One hundred years ago the distinction had not been drawn between a rock and a geological formation, and many very fine-grained rocks were regarded as minerals and were described as such. Thus basalt was supposed to be a mineral species and its columnar

structure was thought to be a peculiar type of hexagonal crystallization. During the early years of the last century progress, it is true, was comparatively slow, but with the introduction of the microscope the science received a tremendous impetus and a great number of enthusiastic workers were attracted to it, so that during the past thirty years or more an immense store of facts has been collected. The system of petrographical classification, however, which has been gradually elaborated, while never wholly satisfactory, is now proving inadequate and unwieldy. It fails, moreover, to express the chemical relationship of rocks. Every year a host of new names, having in themselves nothing to indicate the character of the rocks which they designate, are being introduced and applied to new types or varieties, and the confusion promises to increase with the advance of our petrographical knowledge.

An able historical summary of the development of petrographical classification is given by Cross in the introduction to the volume under consideration, and a new system of classification for the igneous rocks is then presented, based on thoroughly scientific principles and capable of indefinite expansion so as to meet all requirements of the science as it develops. There is no attempt made in the new system to remodel any existing system of classification so as to meet present needs. As the authors state, it would be impossible to do this satisfactorily. An entirely new classification is presented with an entirely new nomenclature—a nomenclature, however, based on mnemonic principles so that it can be grasped and remembered with comparatively little effort.

Before passing to the examination of this new classification, however, it must be pointed out that the authors really present two systems of classification for the use of geologists—a simple or general classification for use in the field, based altogether on the megascopic characters of rocks—and a second much more elaborate and detailed classification which is to be employed after a more complete study of the rock has been made. These two systems are in agreement with each other, the second forming in a way an extension or elaboration of the first. The classification for field purposes retains the common names now in general use, granite, syenite, diorite, basalt, melaphyre, etc., although in some cases giving the terms a rather more comprehensive meaning than they have at present. Thus syenite is made to include all coarse-grained igneous rocks, rich in feldspar, the feldspar, however, being either orthoclase or plagioclase. The term thus embraces, in addition to the normal syenites, the anorthosites, as well as the more feldspathic monozonites, diorites and gabbros of the present classification. However, it may be said that, so far as the field geologists are concerned, the general classification proposed will not differ from that at present in use to such an extent as to cause any inconvenience in applying it. For them, in fact, petrographic classification is made distinctly easier.

The more detailed classification is based on the chemical composition of the rocks, all rocks of a like chemical composition being grouped together. The rock is thus classified according to the composition of the magma from which it solidified. The classification is, furthermore, *quantitative*, and is thus admirably adapted for purposes of comparison and for studies in rock differentiation, which are playing so important a part in modern petrographical work. A chemical analysis or a microscopical examination of the rock is required before its place in this classification can be determined—except in a very general way.

The chemical composition of the rock being known, its mineral composition is first calculated. This is readily and quickly done by the aid of the valuable tables appended to the book. Since, however, the same magma may, under different conditions, crystallize out in different mineral combinations, a certain clearly defined method is followed in these calculations, giving that grouping of minerals which the magmas on cooling usually develop. This percentage mineral composition of the rock expressed in these standard minerals is called the *norm*, a mineral composition which the magma would normally

assume. If for any purpose we wish to calculate the percentage mineral composition of the rock, giving the exact proportion of minerals actually present, full explanations as to the method to be followed are also given, this constituting the *mode* of the rock, or the manner in which the chemical elements have actually arranged themselves. As a general rule, the *norm* and the *mode* of a rock agree closely.

No classification, however, which requires a chemical analysis of a rock before the position of the rock can be determined and a name given to it, would be susceptible of general use. Consequently a method is indicated by which it is possible to determine the chemical composition of a rock without the aid of such an analysis. Rosival has recently shown that if a few thin sections of a rock are taken, the relative proportions of the various minerals constituting the rock may be determined by measuring under the microscope the diameters of each crystal in lines running arbitrarily across the thin sections in question, care being taken to measure a distance at least 100 times as great as the average diameter of the constituent grains. The values obtained will correspond to those of the volumes of the several minerals present. The relative weights of the several minerals may be deduced from these volumes by multiplying each by the specific gravity of the mineral and reducing the whole to 100 parts.

The approximate chemical composition of the several minerals can be determined from the known composition of these species in similar rocks, and from these data the composition of the rock as a whole can be easily calculated. From this, in its turn, the *norm* may be obtained.

In the case of glassy rocks or those containing a large amount of unindividualized material, a chemical analysis is necessary, just as it is for that matter in many cases in the system of classification now employed.

The *norminative* mineral composition and the chemical composition of the rock being thus ascertained, its position in the classification can be readily determined. For this purpose the rock-making minerals are divided into two groups, namely, those which are characterized by a high content in silica, aluminium and alkalis, and those characterized by a high content of iron and magnesia. The first group is known mnemonically as the *salic* (silica-alumina) group and the second as the *femic* (ferro-magnesian) group. On the relative proportion of the minerals of these two groups present, rocks are divided into five *classes*, according to whether one or other of these groups is *extremely abundant* or merely *dominant*, or whether the minerals of the two groups are present in about equal proportions. These five classes are thus characterized (commencing with the most *salic*) as the persalane, dosalane, salfemane, dofemane and perfemane. These classes are subdivided into *orders* according to the relative proportions of minerals forming the predominant group in each case. Thus in the preponderatingly salic classes the order will be based on the relative amount of quartz, feldspars and feldspathoids. The orders in their turn are subdivided into *rangs* (an archaic equivalent of *ranks* used to avoid confusion with this latter term), on the ground of the chemical character of the bases in the minerals of the preponderant group in each case; thus, if these were feldspathic, the fivefold division would be made according to the proportion of alkalis to lime in the feldspars. The lowest division, known as a *grad* (an archaic form of *grade*), is based on the relative amounts of the minerals composing the subordinate group in the rocks. In addition to these, further subdivisions are provided for, when necessary, by *subclasses, suborders, subrangs* and *subgrads.*

The system demands an entirely new nomenclature; in fact any attempt to adapt the old nomenclature to the new system would result in the direst confusion. A new nomenclature in its entirety has accordingly been elaborated, but, being based upon a definite plan, is easily grasped after a little practice. Each name consists of a root derived from some geographical name, the name of some locality where the rock in question is typically developed, the localities being chosen impartially from all countries, thus giving an inter-

national complection to the scheme. To this root is added a suffix which varies in a definite way so as to indicate class, order, rang and grad. For these respective divisions, the letters *n, r, s, t* are employed, in conjunction with the vowel *a,* thus giving in English, *ane, are, ase* and *ate.* In *subclass, suborder,* etc., the vowel is changed to *o,* thus giving *one, ore, ose* and *ote.* An example of the working of the system may prove of interest.

In many parts of the world in recent years occurrences of a peculiar syenite have been found, the rocks being rich in alkalis and usually light in color. They sometimes contain a little nepheline; in other cases this mineral is absent. A number of names have been given to local varieties of this rock, pulaskite, nordmarkite, lauvikite, etc. When any new occurrence is described an attempt is made to bring it under one or other of these terms, or perhaps a new varietal name is suggested. How many of these varieties, often more or less overlapping one another in their characters may eventually be named, it is at present difficult to say.

Now, under the proposed system, the *norm* of any new occurrence having been ascertained, it would at once be seen that the rock belonged to the class *persalane,* for the feldspars would form almost the entire rock. Then it would be found that the quartz or nepheline present occurs in very small amount, less than one seventh of the feldspar. This would bring the rock into the fifth *order* of the *persalanes,* namely, the *canadares.* The question as to the proportion of the alkalis and the lime in the rock would then present itself. If this proportion be more than seven to one, the rock belongs to the first *rang* of the *canadares* and is a *nordmarkase.* If, further, the soda is dominant over the potass, being present in the proportion of between three fifths and one seventh, the rock belongs to subrang 4 and is a *nordmarkose.* If the relative proportion of lime to alkalis be greater than one to seven, the rock falls into rang 2 and is a *pulaskase*—and, the relative proporton of soda and potass remaining as above, into the *subrang lauvikose.*

It will thus be seen that it is possible to compare accurately the newly described variety with those types already established and to classify it with that with which it is most nearly identical. The name assigned to it, moreover, shows at once just how and to what extent it differs in composition from any and each of the varieties already known.

As will be seen, the volcanic or plutonic character of the rock (so important in the schemes of classification employed by Rosenbusch or Zirkel) has not been taken into consideration in naming the rock. A qualifying adjective, however, is prefixed to indicate the texture of the rock, which is, as a general rule, determined by its solidification at the surface or in the depths of the earth's crust. The qualifying adjectives employed are those now in general use, viz., granitic, trachytic, ophitic, porphyritic, etc. This, added to the magmatic name, will give a compound name which accurately describes not only the composition, but the texture of the rock.

It is impossible to refer to more than the main outlines of this new scheme of classification, but, as will be found by perusal of the book, the whole question has been most carefully thought out, every possible case considered and the scheme tested by applying it to thousands of rock analyses. It, further, has the merit of being presented in clear and idiomatic English, so that it can be readily understood. It is the result of some ten years' work on the part of four of the ablest petrographers in America, during which time many different methods of classification have been successively drawn up and tested, only to be found to break down in some important particular. The present scheme is thus the result of a long course of investigation and very mature deliberation. With a little experience the calculations required for the application of the system can be quickly made, especially with the aid of the tables given in the book for that purpose. By such calculations, furthermore, it is possible to check the accuracy of the chemical analysis of the rock and in many cases to point out the nature of errors, if any have been made. A higher degree of accuracy is thus secured in petrographical investigation.

It is hardly to be expected that an entirely new classification such as that proposed will at once be universally adopted, but it is believed that as time goes on it will recommend itself more and more to petrographers as a *quantitative* system of classification, much more precise and definite than any that has been hitherto proposed, and having the further advantage of being based on thoroughly scientific principles and capable of indefinite expansion, if necessary, to meet the growing needs of the science. FRANK D. ADAMS.

McGILL UNIVERSITY, MONTREAL.

Ueber das Hirngewicht des Menschen. By F. MARCHAND. Abh. d. math.-phys. Classe d. Königl. Sächsischen Ges. d. Wissensch., Bd. XXVII., 1902, No. IV., pp. 393–482.

Professor Marchand, of Marburg, has accumulated the largest number of human brain-weights ever published, and in a large series of tables, containing 1,169 cases, he gives a thorough analysis of these data. Marchand discusses the influences affecting the weight of the brain, such as the cause of death, bodily stature, sex and age. He finds a notable increase in the brain-weight of persons dying of diphtheria and other acute diseases, owing, no doubt, to the hyperæmia and œdema of this organ. In new-born children the average weight is 380 grams for males and 353 grams for females. Combining with these the infants less than one week old, the averages are 371 grams for males and 361 grams for females. These weights are doubled by the end of the first year, and tripled at the end of the third. After the fifth year the increase in the weight of the brain is more gradual. The figures show that in most persons the maximum brain-weight is attained at about the twentieth year in males, the average being about 1,400 grams, and at about the seventeenth year in females, the average being 1,275 grams. The reduction of the average brain-weight due to senile atrophy occurs in the eighth decade in men and in the seventh decade in women. The maximum absolute weight in Marchand's series was 1,705 grams in a male. Many high brain-weights were omitted from the tabulations on account of hydrocephalus, brain-tumor, meningitis and other brain affections. Low brain-weights, less than 1,200 grams in males and less than 1,100 grams in females, constituted about five and seven per cent., respectively, of all the cases, usually in phthisical subjects or in those dying of wasting diseases. The tables show a certain relation existing between the stature and brain-weight, but the ratio of increase is a very inconstant one. Finally Marchand discusses the relation of the sexes as to their brain-weight, and concludes that the lesser weight of the brain in women is not alone dependent upon her smaller stature, for a comparison of both sexes of the same stature shows the male brain to be invariably the heavier. In the growing child, until a stature of seventy centimeters is attained, the brain-weight increases proportionately to the increase in body-length, irrespective of age or sex; thereafter, however, the male brain begins to outstrip that of the female. Woman's lesser brain-weight, like her lesser head-circumference, as compared with males of the same stature, seems to be an expression of the different organization of the female body.

E. A. S.

SCIENTIFIC JOURNALS AND ARTICLES.

The Popular Science Monthly for February has for frontispiece a portrait of Carroll D. Wright, president of the American Association. Asaph Hall has an article on 'The Science of Astronomy,' in which attention is called to the influence of science in promoting harmony among nations. Bradley M. Davis discusses 'The Evolution of Sex in Plants,' as illustrated by the Algæ. Alverton W. Price shows 'The Economic Importance of Forestry,' and Frederick A. Woods gives the seventh of his papers on 'Mental and Moral Heredity in Royalty,' this one dealing with the house of Nassau and Brunswick. An account of 'The Smithsonian Institution' is reprinted from its last report. Roger Mitchell discusses 'Jewish Immigration,' showing that it presents a somewhat serious problem in New York. Wesley Mills treats of 'The Behavior of Blind Animals,' adducing instances to show how great

is the effect on the disposition of the animals, and George M. Sternberg tells of the history and possibilities of 'Preventive Medicine.' Finally, J. McKeen Cattell presents 'A statistical Study of Eminent Men.'

The Plant World for January starts a new volume in a new dress, with a cover in two colors designed by Mr. Shull. Having changed its publisher and been copyrighted, it will henceforth appear promptly. It contains 'Obtusilobata Forms of Some Ferns,' by C. E. Waters; 'The Preservation of Our Native Plants,' by Ruth E. Messenger; 'Dimorphism in the Shoots of the Ginkgo,' by G. N. Collins; and numerous short articles and notes. 'The Families of Flowering Plants,' which has been running for three years as a supplement, has been completed, and for the present four pages are added to the size of the journal.

The Zoological Society Bulletin for January contains a description of the recently completed lion house in the New York Zoological Park with notes on its contents, which were mainly presented by friends of the society. A list of the more interesting animals includes a pair of snow leopards, another of Prejvalsky horses, a cape hunting dog (*Lycaon*) and a Tasmanian wolf. This last is the second specimen brought to this country alive, the first being in the National Zoological Park. It is rather surprising to learn that the cheetah is now rare in captivity, at least outside of India. The number contains a brief account of the New York Aquarium and its work.

The Museums Journal of Great Britain for January has an account of the Dutuit Bequest to Paris, which comprises, besides other art treasures, many rare and beautiful books. The collection has been in process of formation since 1832, and had been so well cared for that many of the specimens had never been unpacked. Among the many notes is recorded the formation for the Sydney Museum, New South Wales, of a collection of colors and chemicals used in color making, with samples of fabrics dyed with them.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 32d annual meeting was held December 20, 1902. A new code of by-laws was adopted, the principal change from the old code consisting in the statement of the powers of the general committee in conformity with the statute under which the society is incorporated, and the establishment of an executive committee to care for routine business.

The report of the secretaries showed a present active membership of 110, a net gain of 2 during the year; besides the annual meeting 16 meetings have been held, with an average attendance of 37; 38 papers were presented.

The treasurer's report showed a gross income of about $950 and expenditures of $460.

Professor J. H. Gore, of the Columbian University, was elected president for the ensuing year; Messrs. Hagen, Marvin, Littlehales and Abbe were elected vice-presidents. The treasurer, Mr. Green, and the secretaries, Messrs. Hayford and Wead, were reelected, and the following were elected on the general committee: Messrs. De Caindry, Paul, Winston, Watkins, Briggs, Fischer, Bauer, Day and Harris.

The meeting regularly falling on January 3, 1903, was ordered omitted on account of the meetings of the American Association for the Advancement of Science during the week on which that date fell.

The 561st meeting was held January 17, 1903, with the new president, Professor J. H. Gore, in the chair.

The evening was devoted to reports from the committee on mathematical science.

Professor Cleveland Abbe, of the U. S. Weather Bureau, spoke of the German Mathematical Union and the new 'Encyclopædia of Mathematics.' The Mathematical Union or Association originated as a branch of the Association of German *Naturforscher und Aerzte* at the Heidelberg meeting of 1889, and its duties were definitely formulated at the Bremen meeting in September, 1890. It now numbers about 550 members; it has published two or three miscellaneous volumes, such as a list of German mathematical theses by can-

didates for the degree of Ph.D., and the catalogue of mathematical apparatus, by Professor Walter Dyck. Its principal publication has been eleven volumes of 'Annual Reports,' containing elaborate reviews of progress in the various branches of mathematics and its applications. In 1894, at the Vienna meeting, the publication of a 'mathematical lexicon' was decided upon, but at the Frankfort meeting of 1896 it was concluded best to combine this idea with the 'Encyclopædia of Mathematical Sciences,' undertaken by Professor W. F. Meyer, of Clausthal, and Professor H. Burkhardt, of Zurich. The mathematical union has, therefore, united with the Scientific Association of Göttingen and the academies of science at Munich and Vienna in becoming responsible for this latter work. It was originally estimated that the encyclopædia would consist of seven volumes in ten distinct parts besides the general index, but the portions already printed show that the whole work will be larger than was expected. The publication has proceeded by parts as follows: 1898, one; 1899, four; 1900, three; 1901, three; 1902, four. These parts are scattered through the encyclopædia as follows: Volume I., seven parts and completed; II., four parts; III., one part; IV., three parts. It may, therefore, be expected that five or six years will still elapse before we shall approach the end of this great work.

Mr. Abbe exhibited the fifteen parts already received, and they were examined in detail by the audience. He remarked upon the chapters treating of the theory of numbers; that on mathematical economics; the memoirs on differential equations; the chapter on mathematical apparatus and machinery, and especially the two memoirs by Professor A. E. H. Love, of Oxford, on the physical basis and the theoretical development of hydrodynamics.

Professor Frank H. Bigelow, also of the Weather Bureau, summarized the 'Applications of Mathematics in Meteorology.' Meteorology has suffered in the past by the misapplication of mathematical theories to the explanation of cyclones and anticyclones, and also of the general circulation. It has been shown that Ferrel's vortex and Oberbeck's vortex do not agree with the modern observations of the local circulation of the air; also, that the theories of these authors must be greatly modified to fit the facts of the movements of the atmosphere in general. Similarly, there has been a tendency to misapply the theory of least squares, and the probability curves, in discussing the periodic cycles observed in the solar and terrestrial atmospheres. These theorems require that the events shall be independent of one another, but in such thermodynamic circulations this is not the case.

The next paper was 'On the Foundations of Geometry and on Possible Systems of Geometry,' by Dr. Henry Freeman Stecker, of Cornell University. In the absence of Dr. Stecker his paper was presented by Mr. Radelfinger.

After an introduction on the assumption which must be made in constructing a geometry, Dr. Stecker reviewed the criticisms of Moore and Schur of Hilbert's classic paper of 1899, recently translated, and announced the conclusions that in spite of all criticisms and attempted improvements Hilbert's system has 'withstood all attacks and remains not only apparently sound in logic, but the simplest of such systems as have thus far been constructed.'

An account was next given of Hilbert's second, and recent, great memoir, *Math. Annalen*, Bd. 56, which has for its object to establish Lie's well-known and indispensable results, without the assumption, made by Lie, that the functions defining the displacements are differentiable. In solving the problem Hilbert makes use of Cantor's theory of point-assemblages and Jordan's theory of a closed curve free from double points. Hilbert's results, so far as they go, establish the independence of Lie's results of the assumption stated above, but they have yet to be extended to elliptic geometry and also to space.

In conclusion, a thesis by Hamel, a pupil of Hilbert's, was discussed, which leads to the conclusion that 'from the standpoint of the calculus of variations the Euclidean geometry is the simplest possible.'

A fourth paper, by Mr. F. G. Radelfinger,

'On the Analytic Representation of Functions,' was postponed till a later meeting.

Charles K. Wead,
Secretary.

THE TORREY BOTANICAL CLUB.

The club held its regular annual meeting for election of officers at the College of Pharmacy Building, January 13, Dr. Rusby in the chair. The following officers were elected for 1903:

President—Hon. Addison Brown.

Vice-Presidents—Dr. H. H. Rusby and Professor E. S. Burgess.

Treasurer—Professor F. E. Lloyd.

Recording Secretary—Mr. F. S. Earle.

Corresponding Secretary—Dr. John K. Small.

Editor-in-Chief—Dr. John H. Barnhart.

Associate Editors—Dr. N. L. Britton, Dr. T. E. Hazen, Dr. M. A. Howe, Dr. D. T. MacDougal, Dr. W. A. Murrill, Dr. H. M. Richards and Miss Anna Murray Vail.

The treasurer reported a favorable balance in the treasury. The editor reported that 1902 had been the most productive year in the history of the club both in number of pages printed and in plates. An increase of fifty per cent. in the outside subscriptions to *Torreya* was reported, making this publication practically self-supporting.

F. S. Earle,
Secretary.

THE AMERICAN BOTANICAL CLUB.

During the latter half of the year 1902 a new organization known as The American Botanical Club has entered the field of botany. While yet in its infancy, the club has met with remarkable success, having at the close of 1902 an enrolled membership of seventy-six, covering a large portion of the country.

While very liberal in its scope, so as to admit the less advanced students, the club has undertaken an important work by the encouragement of the study of plant life and the preparation of members for deeper research.

Officers for 1903 have been elected as follows:

President—Willard N. Clute.

Vice-Presidents—Miss Pauline Kaufman and Miss Angie M. Ryon.

Secretary—J. C. Buchheister.

Treasurer—Frank A. Suter.

F. A. S.

THE BERZELIUS CHEMICAL SOCIETY.

The 81st meeting of the Berzelius Chemical Society was held in the Agricultural Department Laboratory, Raleigh, N. C., Wednesday afternoon, January 28, 1903. The program was filled by Messrs. C. B. Williams and F. C. Lamb.

Mr. C. B. Williams presented a very interesting abstract of a report of work recently done at the Imperial University of Japan, on 'The Occurrence of Manganese in Plants,' pointing to the conclusion that this element plays a far more important part in plant nutrition than is usually supposed.

A paper was read from Mr. F. C. Lamb, which embodied work recently done by Mr. Lamb in behalf of the Department of Agriculture in the investigation of 'Condimental Stock Foods.' From the work done it is plainly evident that the claims made by the manufacturers of these condimental powders are in most cases perfectly absurd, and the prices charged exorbitant. The powders examined were found to be composed almost entirely of the simple home remedies which have been used by every country 'horse doctor' from time immemorial.

The following officers have been elected for the ensuing year:

President—C. B. Williams.

Vice-President—W. G. Haywood.

Secretary-Treasurer—J. S. Cates.

Abstractors—G. S. Fraps, S. E. Asbury, P. R. French, F. C. Lamb, W. A. Syme, J. M. Pickell, W. G. Haywood and C. B. Williams.

J. S. Cates,
Secretary.

THE ONONDAGA ACADEMY OF SCIENCE.

The academy met on January 23 and elected the following officers for the coming year:

President—Dr. E. H. Kraus.

Vice-President—John D. Wilson.

Secretary—Philip F. Schneider.

Corresponding Secretary—Dr. T. C. Hopkins.

Treasurer—Miss Louise W. Roberts.

Librarian—Mrs. L. L. Goodrich.

At the meeting on December 21, Dr. M. W. Smallwood gave an illustrated lecture on the dinosaur fields of Wyoming, based on his visit to that region two years ago. He showed

many interesting views of the dinosaur bones, the quarries and the scenery of the region in which they occur.

T. C. Hopkins,
Corresponding Secretary.

DISCUSSION AND CORRESPONDENCE.

THE FALL OF BODIES.

The report of Professor E. H. Hall on the motion of falling bodies recalls an interesting experiment. It was proposed by Newton in order to obtain a proof of the rotation of the earth. The experiment was made by Robert Hooke in 1680. Hooke dropped a ball 27 feet, and it fell toward the east and south. The most complete experiments have been made in Germany. Benzenberg dropped balls 235 feet, and found a small deviation to the south and a marked deviation to the east. His first sixteen trials gave a deviation to the north, but the last fifteen trials more than balanced this. Two years later Benzenberg repeated his experiments, and found a small deviation to the north. It appears to have been the erroneous investigation of this question by Olbers that led Gauss to examine the theory of this motion. Gauss says that, to his astonishment, he found by theory no deviation to the south. Afterwards Laplace examined this question ('Mec. Cel.,' Tome IV.) and found no deviation to the south. The most complete experiment is that of Professor Reich, who dropped balls 488 feet. From 106 trials the deviation to the east was 23.30 mm., and to the south 1.06 mm.

The result appears to be that the deviation to the east is decided, and that to the south or north is so small that it can be ascribed to errors of observation. The probable errors of the results are large. Perhaps good conditions for this experiment can be found in our country.

A. Hall.

February 4, 1903.

MOUNTAIN SPECTRE NEAR BOULDER, COLORADO.

The term 'mountain spectre' is taken from the Encyclopedia Britannica, where it is noticed under the article 'Halo.' The best-known example is at the Brocken in the Harz Mountains. From the description of the phenomenon as observed at that place, it is inferred that the appearance noted in Colorado was quite as distinct as that at that famous locality. It was observed February 1 from the top of Green Mountain, near Boulder, Colorado. This mountain is a high point in the foothill belt; its summit is 2,500 feet above the plains which it overlooks, or about 7,800 feet above the sea. On the day mentioned, at 4:30 p.m. patches of white cloud were drifting below its summit. Occasional snow flurries visited the plains below. The temperature was apparently below the freezing-point. At the hour of observation the sun, which was not more than twenty degrees above the horizon, was shining clear at the summit. Opposite the sun, a few hundred feet distant, was a mass of white or grayish cloud. Upon this cloud was seen a complete circle of rainbow colors. The diameter of the most pronounced red ring was estimated at nine degrees. Outside of this was a faint blue color, and then a suggestion of red in a still larger circle. Within the nine-degree red ring were blue and violet, the center appearing a dull lavender. In the field within the bright red ring appeared the shadow of the observer, which was so definite as to reproduce all movements of arms and hands. Each observer saw his own shadow and the reproduction of his own movements, and could see nothing of the shadow or movements of his neighbor if standing more than six or eight feet away. The phenomenon was watched about twenty minutes.

N. M. Fenneman.

University of Colorado.

SIGNS OF THE GLACIAL PERIOD IN JAPAN.

In my visit to Japan a few years ago I failed to find any distinct signs of glacial action, though I penetrated what seemed to be a typical place for extinct glaciers in the mountainous region one hundred miles northwest of Tokyo. But Mr. Yeijiro Ono, of the Bank of Japan, has just sent me a translation from a Japanese paper of some observations in the mountainous district a little farther south than that visited by me, which would seem to indicate that there are some relics of the glacial period in the central highlands

of Japan. The translation is interesting, not only as settling a fact of importance, but as indicating the alertness of the Japanese mind in prosecuting scientific inquiry. The article is from the *Zigi-shimpo* of November 5, 1902.

G. Frederick Wright.

Oberlin College,
February 4, 1903.

Nobody has ever found a trace of a glacier in our country, and in fact it has often been doubted that one existed in Japan. Professor Milne, of England, who once held a chair in the Imperial University of Tokyo, even went so far as to deny its existence in Japan. It is, therefore, interesting to learn that Professor Yamazaki, of the Higher Normal School of Tokyo, recently found a trace of one on a mountain side in Shinano. When he was interviewed, he gave the following accounts of his discovery:

"The fact that America and Europe were once covered with ice is now beyond dispute; and recently we heard that traces of a glacier were found in Australia; and I have always held a theory that Japan is qualified to have a glacier, for the following reasons.

"1. There are several mountains as high as and above 3,000 meters.

"2. Many of them are covered with perpetual snow.

"3. The climate, being 'oceanic,' the amount of rain and snow is greater here than it is in Europe.

"4. In America, I found that the glacier region comes as far south as the lowest extremity of 37′ 60″ N. L. Now, Tokyo being on 35′ 41″ N. L., the middle part of the island along the coast of the Japan Sea corresponds with the glacier region in America.

"I had held this as a mere theory until last August, when I actually found traces of a glacier in one of the northwestern mountains.

"Last August, as a Committee on the 'Prevention of the Earthquake Disasters,' I climbed up a volcano, located on the boundary of three countries, Shinano, Yetchu and Yechigo; and when making investigations in Hida range, I actually fell upon a trace of a glacier on the side of Shira-Umaga-Take. This place, which is 2,900 meters above the sea, forms a sort of valley, extending, say, for about 200 yards, and the layer of snow is about 20 yards deep. The sides of the valley are composed of slate-rock and sand. Pebbles and pieces of rock found on the mountain are unlike those which we generally find in ordinary mountains—smooth and striated. The rocks along the snow line are marked with grooves and the rock-floor is marked by the grinding work done by a glacier. In a still lower part of the valley, further down, I found stones and rocks traversed in every direction. I have found sufficient evidence to form a belief that here we have the proof of the existence of a glacier in Japan. The erosion is effected by the ice pressing against the sides, as it crept along, taking sand and stones which fell from the sides. If we should follow the range up to the province of Hida, I believe, we should find more valuable proof of the existence of glaciers. At any rate, we certainly have sufficient proof now for clearing the doubt of the existence of glaciers in this country.

"It is a strange coincidence, but a few days later, Professor Yabe found a zone of vegetation like that of the Alps and Chishima, in the very same place."—As he was interviewed by the editor of *Zigi-shimpo*.

November 5, 1902.

SHORTER ARTICLES.

TYPES OF PRE-LINNÆAN GENERA.

Instability in the application of generic names is undoubtedly the most serious remaining deficiency of our current systems of biological taxonomy. To secure stability of specific names a definite rule of priority was sufficient because it had occurred to nobody to deny that the specimen first named and described should constitute the type of the species and determine the application of the specific name. With genera also stability is not to be secured merely by observing priority of dates, since it is necessary that writers agree upon the application of a name as well as upon its age; but by treating each generic name as inseparably attached to a single species as its nomenclatorial type, the law of

priority is rendered as effective with genera as with species.

Many systematists have been content to follow in a general way the varying nomenclatures of their predecessors, while others who have appreciated the importance of uniform procedure have experimented with what has been called the method of residues or elimination, under which a generic name is inherited by the last species left in the genus after all possible segregations have been made. This plan is defective in theory, very difficult of application, and does not bring about uniformity in practice, because different systematists commonly differ as to which species were rightly removed from the genus, and consequently as to which in reality remained to the last. Those who look upon stability as the prime requisite of a system of formal nomenclature are accordingly beginning to abandon elimination in favor of the selection of types by a definite method of priority, but progress in this desirable direction is greatly retarded by the fact that the rule which recognizes 1753 as the beginning of binomial nomenclature would have the unforeseen and very undesirable result of associating many old and well known generic names with species for which they are not currently used, that is, if it were not possible to find a means of avoiding the difficulty.

It seems certain that the consistent application of any method will result in many changes of names, since even in instances where genera were established for single species their names have frequently been slipped along to groups of plants quite unknown to the original authors. Rather than run the risk of having to use old names in new and unexpected places, some would give over the attempt at securing stability. But to those who perceive that taxonomic study is largely a waste of time unless it can be carried on under rules which guarantee uniform nomenclatorial results, no changes essential to the application of such an improved method will seem intolerable or ridiculous, though to make unnecessary changes, even to carry into effect a good rule, would be foolish. Because the guinea-pig would become *Mus* and the giraffe *Cervus* is not a reason why we should not, in general, treat the first species as the type of its genus; it is simply a reason why we should find, if possible, a means by which an undesirable incident may be avoided without losing the important advantage of a method which all can apply with uniform results. The plan of treating the generic names adopted from pre-binomial writers as a special case should not be opposed even as an exception to the general rule, since with these we are not dealing with the normal method of establishing genera, but are attempting to arrange as smooth a connection as possible between two periods of botanical history. It is true that we are not following the intent of eighteenth-century authors, since we now think of generic names as attached to species rather than to definitions or concepts, but this should not make us unwilling to preserve as many of the older names as possible, nor careless in applying them as nearly as possible in accordance with historical usage.

Many of the older generic names which would be transferred by taking either the first or the last Linnæan species as type may be kept in their customary places by selecting as types species having such names as *officinalis, utilis, communis, vulgaris, verus, typicus* or others indicative of botanical prominence or popular interest. A rule containing a list of such names would facilitate the selection of types and would be open to no charge of indefiniteness.

Another practical suggestion is that instead of taking as types the first species placed by Linnæus under names adopted from pre-binomial writers, we take the species under which Linnæus gives the oldest citation under the same generic name. This would place the question of types on a definite basis of chronology, and opens no doors to individual differences of opinion. It would require considerable bibliographic labor to locate the oldest citation under some of the larger genera, though this task is much more simple and direct than the method of elimination. The utility of such a rule for the purpose for which it was intended will depend, however, on whether Linnæus followed a method of

citation of such consistent historical thoroughness that his oldest references generally fall on the oldest and best known species of each genus. The indications are that he did not, but often gave citations to old books under relatively little known species which were not well represented in the writings of his more immediate predecessors.

If this should prove to be the case we would save names as well as labor by beginning our historical investigations with Tournefort, who was generally careful to place the most common and best known species at the head of his list. Moreover, such a limitation would enable us to frame a rule of much more direct and easy application, for instead of being obliged to compare the chronology of the Linnæan species of a genus we could simply look for its type where the name first appeared in Tournefort's 'Institutiones' or some later work. If it were found that this species had been included as a binomial in the 'Species Plantarum,' or wherever the generic name was first used by a binomial author, this would constitute the adoption of the pre-Linnæan genus, and its type species would have been determined historically, but still in an entirely definite and invariable manner. Such a rule might read something as follows:

A genus is treated as having been adopted from Tournefort or a later nonbinomial writer when its type species was included under the first binomial use of the name.

This rule would have the further distinct advantage that generic names borrowed by Linnæus from older literature, but applied to new groups of plants, would not be disturbed, since their pre-Linnæan types would not be found under the Linnæan use of the name, which would then be treated as though it had originated with Linnæus or any later botanist. Generic names, like those of species, would have a definite order of priority under the binomial system of nomenclature. All the real advantages of beginning generic nomenclature with Tournefort would be secured, without the folly of resurrecting the many generic names which did not come into use under the binomial system, but have rested in oblivion for a century and a half.

It has seemed desirable to call attention to this alternative suggestion at the present time because its merits can be most readily and satisfactorily investigated while botanists are testing the recently proposed rule to select types of Linnæan genera on the basis of the oldest reference. O. F. Cook.

Washington,
February 3, 1903.

A GRANT FROM THE CARNEGIE INSTITUTION FOR PALEOBOTANY.

The executive committee of the Carnegie Institution has approved a grant of $1,500 to G. R. Wieland, of the Yale University Museum, for the continuation during the year 1903 of his researches on the structure of the living and fossil cycads. In connection with this announcement the following brief statement is appended concerning the extent and progress of cycad investigation:

The cycadaceous nature of certain silicified stems with leaves and fruits unknown, from the English Wealden, was recognized as early as 1825. Nearly fifty years later Carruthers studied a similar remarkably preserved trunk from the Lower Greensand of the Isle of Wight, in which he discovered between the old leaf bases, which were thickly covered by ramental hairs like those of ferns, wonderfully preserved and nearly mature ovulate strobili of entirely different structure from those of any cycads known.

About this same time Williamson described certain cycadean leaf imprints as found associated with trunks and various casts of fruits of puzzling character from the cliffs of Hawkser and Runswick on the south coast of England. Nevertheless, these plants remained one of the most interesting of all paleobotanical riddles for the next thirty years, our knowledge of them being confined to their trunk structure and the ovulate strobilus, though it should be mentioned that Capellini and Solms found pollen grains in an imperfectly preserved fruit borne on a trunk found at the ancient Etruscan Necropolis of Marzabotto, thus showing that whatever the character of the male fructification, it must have been borne laterally like the seed-bearing cones.

Although handsome specimens of these cycad, or Bennettitalean trunks were found in this country between Baltimore and Washington as early as 1851, they were not observed to present any new structural details, and remained, as in Europe, among the rarest of fossils until the discovery in quick succession some ten years ago of numerous additional Maryland specimens, and the first of the highly important new localities in the Black Hills and Wyoming. At this time superb trunks from the Black Hills were obtained by the Smithsonian Institution, while still others of importance were collected by Professor Macbride, of the Museum of the State University of Iowa. In the meantime Professor Marsh became deeply interested, and with remarkable foresight and success secured for the Museum of Yale University the most extensive and valuable of all cycad collections. Yet another interesting series of trunks is that from central Wyoming belonging to the State University at Laramie.

The macroscopic study of the American material has been carried on by Professor Lester F. Ward, and its structural investigation by the writer.

The preliminary studies of the latter thus far published include in part the discovery of the leaves with their structure and prefoliation, additional facts concerning ovulate fructification, and, of most importance, the form, prefloration and principal structures of the bisporangiate strobili. These, like the ovulate cones, owe their marvelously perfect preservation, in large measure, to their protected position among the old leaf bases. They are found unexpanded, but quite mature and complete in every detail. Moreover, the features present indicate with exactness the appearance that must have been presented in life by the strikingly handsome expanded flower or strobilus, which was in some species nearly, or even one foot in diameter.

The microsporophylls, or staminate fronds, bear pollen in sori of a structure identically comparable with those of the tree ferns of the genus *Marattia*, and are the first of their type yet discovered. Their interest from an evolutionary point of view is, therefore, very great, furnishing as they do the most direct evidence yet brought to light of the derivation of the Gymnosperms from ancient Marattiacean Pteridophytes bearing asexual spores. But, at the same time, the plan and other characters of the entire strobilus suggest much as to the possible manner and method of the evolution of the Angiosperms. In addition, these studies have already brought about a better understanding of the true character of various related but hitherto problematical fossil casts and impressions.

G. R. WIELAND.

YALE UNIVERSITY MUSEUM,
February 5, 1903.

CURRENT NOTES ON METEOROLOGY.

SCIENTIFIC INVESTIGATIONS BY WEATHER BUREAU MEN.

ONE of the most noticeable, and one of the most satisfactory, signs of the development of the United States Weather Bureau is the steady increase in the amount, and the no less steady improvement in the quality, of the original scientific investigations carried on by the rank and file of the Weather Bureau officials and observers. This encouraging advance is due largely to the energy and enthusiasm of the present Chief of the Weather Bureau, and of the more prominent officials of the service, notably Professors Abbe, Bigelow, Marvin, Henry and others. The two annual 'Conventions of Weather Bureau Officials' have doubtless also helped much towards this same end, for at these meetings there is opportunity for the reading of papers, for discussions, and for the promotion of a feeling of fellowship and of a spirit of scientific ambition which are most desirable. The *Proceedings* of the second annual convention of the officials of the Weather Bureau (Bulletin No. 31) is a volume containing a large amount of information of interest to every one who is working along meteorological lines, but the most striking feature of it, in the mind of the present writer, is the evidence it gives of original investigations carried on by Weather Bureau men. Space forbids any attempt at a review of this 'Bulletin.' Indeed, a mere enumeration of the titles of the papers read

at the Convention would occupy a column or two of Science.

CYCLES OF PRECIPITATION IN THE UNITED STATES.

In the *Monthly Weather Review* for October, Mr. L. H. Murdoch, Section Director of the Weather Bureau at Salt Lake City, considers the cycles of precipitation at that station and at other places. He finds for Salt Lake City a dry cycle between 1827 and 1864, during which the average annual rainfall was about 15 inches; a wet cycle from 1865 to 1886, with an average annual precipitation of 18.42 inches, and from 1887 to the present time a dry cycle, the average annual precipitation from 1887 to 1901 being 15 inches. From the records for San Francisco, Sacramento, Denver, Omaha, St. Louis, Cincinnati and Baltimore it appears that the country west of the Rocky Mountains had its wettest cycle from 1866 to 1887, while the middle Mississippi and Ohio valleys received their heaviest precipitation from 1840 to 1859. The present dry cycle is general from San Francisco to Baltimore. Mr. Murdoch finds no relation between his rainfall curves and Wolfer's sunspot tables, and concludes 'that there is no known natural law by which we can predict the length of the present dry cycle.'

The rainfalls for certain stations in the United States, it may be recalled, have lately been studied by Brückner, who finds that they correspond very well with his thirty-five-year climatic period. Mr. Murdoch makes no reference to Brückner's work along these lines.

R. DeC. Ward.

CURRENT NOTES ON PHYSIOGRAPHY.

ABANDONED CHANNELS OF THE MONONGAHELA.

The Masontown-Uniontown folio of the Geologic Atlas of the United States by Campbell describes a part of the Alleghany plateau in southwestern Pennsylvania. The higher plateau, east of Chestnut-Laurel ridge, is referred with some doubt to a much wasted stage of the uplifted Cretaceous peneplain of the Appalachian province; the lower uplands, further west, represent an Eocene peneplain, now maturely dissected. The chief river is the Monongahela, whose curving valley had been already well graded and opened by early glacial times; since then the river has cut a narrow trench 150 feet below its former valley floor. The trench is still so young that only slender discontinuous strips of flood plain are developed along it, on the inner side of curves; while the larger side streams enter the main valley with a strong slope, and still preserve the open flood plains of the earlier cycle in their middle course. But the most peculiar features of the district are the abandoned channels of the Monongahela at the level of the open valley floor. These are not normally cut-off, round-about channels, like those of the Meuse and Moselle, abandoned by wearing through the necks of the spurs that the river once contoured; for the new courses of the Monongahela are cut through broad, stout spurs for distances of a mile or more. Moreover, the abandoned channels are much clogged with silt, sand and gravel, with some boulders, to depths of 100 feet. Features of this kind are known in connection with several other north-flowing rivers not far south of the glaciated area, the most noted example being the heavily silted Teay valley, from which the Kanawha has turned northward to the Ohio. Campbell suggests that the new courses were taken when the old valleys were locally obstructed at various points by ice dams during the Kansan glacial epoch; each dam is supposed to have gained such strength that it endured for many years, and such height that it surmounted the level of some saddle among the hills on one or the other side of the main valley. Then silts and gravels were deposited in the ponded part of the river, while the new channel was incised in the saddle of overflow. The uplift by which the deepening of the new valleys below the older ones was brought about is dated as post-Kansan.

The hypothesis of local ice-dams, begun during the spring floods of frozen rivers and strengthened on account of the more severe climate of the early glacial epoch, seems at first reading hazardous from the number, height and duration of the dams required. The number of examples is, however, more in favor of the hypothesis than against it: if

the accident happened once, it might become a common occurrence. The height of the dams is in excess of examples ordinarily reported, but not vastly in excess. The duration needed for the dams is of difficult acceptance. On the other hand, the hypothesis is carefully studied out; it is literally a working hypothesis, in the sense that it will account for the observed facts. The alternative hypothesis of laked rivers, obstructed in their northward flow by the ice sheet itself, is of difficult application, in that it does not clearly lead to the desertion of old valleys, unless on the improbable supposition that the lakes were filled by silting and the silts were afterwards in great part removed.

LA CÔTE D'OR.

The headwaters of the Seine and Yonne flow northwest through valleys well entrenched in the calcareous plateau of Langres, in the east-central part of France, whose surface at altitudes of 400 or 500 meters expresses the structure of the region. The Saône flows southward on the broad, aggraded plain of la Bresse at altitudes near 200 meters. Between the two is a dissected escarpment, determined by a fault with downthrow of several hundred meters on the southeast, whose sunny slopes or *côtes* have given name to the department, within the ancient province of Burgundy, of which Dijon is the chief city. Girardin describes the features of this interesting district: 'Le relief des environs de Dijon et les principales formes topographiques de la Bourgogne' (*Ann. de Géogr.*, XI., 1902, 43–53). The several elements of form are taken up in succession and explained in their relation to geological structure, as well as to human occupation. The isolated areas of upland, 'la montagne,' are dry, relatively barren, with few and poor inhabitants, whose number is decreasing. Residual mounds, 'hauteaux, montots, tasselots,' the remnants of once overlying strata, surmount the uplands. The slope, 'la côte,' strewn with stony waste from the rimming bluffs of the 'montagne,' is occupied with vineyards where well exposed to sunshine. Ravines or 'combes' and valleys, frequently with large springs at the stream heads, are gnawing into the uplands from the low plain on the southeast, threatening the headwaters of the Seine system.

The subject of this essay invites fuller treatment in several directions. The development of topographic features in relation to time might be presented to advantage in greater detail: thus a better understanding could be gained of the effects of faulting on form, and of the relation of the montots to the combes. All of the elements of form could be better appreciated by the foreign reader if they were more explicitly related to the type examples of systematic physiography, so that each local instance should be presented as a variant upon a standard of its kind. Finally, several large problems invite attention in this district: What effect had the depression of the Saône basin on the headwaters of the Seine system? At what stage in the development of the valleys of the Seine system did the Saône depression take place? What changes have taken place since the depression occurred? Perhaps the French geologists are in a position to answer these physiographic questions, but the answers have not yet been given by French geographers.

CAÑONS OF THE EUPHRATES.

The narrative of a trip 'Through the Great Cañon of the Euphrates River' on a skin raft, by E. Huntington (*Geogr. Journ.*, XX., 1902, 175–200), includes a graphic account of a number of physiographic features. The stretch of 190 miles along the river included something more than the great northwest bend within which Harput is situated. The journey occupied seven days, although only thirty-seven hours were spent in floating down the river. The region includes many subparallel ranges, trending northeast-southwest, and enclosing as many waste-floored basins. In the basins, the river is incised but little below the basin plain, its channel sometimes forming a braided network on an open flood plain with a fall of only two feet a mile. In the mountains the river follows narrow cañons, from 2,000 to 5,000 feet deep, with steep walls and no flood plain; here the channel is

often roughened with ungraded ledges or half barred with the fans of lateral torrents, and the fall rises to sixteen feet a mile. All these features point to a relatively recent deformation of the country, in consequence of which the river has aggraded the depressed basins and trenched the uplifted ranges. It is noted that only the smaller side streams cascade into the cañon; the larger ones have cut down their lateral ravines to grade with the main river. The analogy of the Euphrates and the Colorado in this respect is pointed out. The stationary condition of the native population is remarkable; the navigation of the river is still in the most primitive condition; an altar was seen 'covered with the gore of the scores of sheep and goats, which are brought as sacrifices by both Christians and Mohammedans'; irrigation is very poorly developed. The people could not understand the motive of the 'men with hats' in making so venturesome a journey down the river. A characteristic comment was: "They say they are not paid for making this journey, but we know better. * * * They know everything; they see a stone or a plant, a brook or a mountain, and they know it. * * * They write everything." A more general article by the same author, on 'The Valley of the Upper Euphrates River and its People,' has lately appeared in the *Bulletin of the American Geographical Society*.

W. M. Davis.

RECENT ZOOPALEONTOLOGY.

AGE OF THE TYPICAL JUDITH RIVER BEDS.

Referring to the recent communication of Mr. J. B. Hatcher and Professor S. W. Williston, on the subject of the age of the Judith River Beds, Mr. Hatcher remarks: 'I do not know upon what authority Professor Osborn makes this unqualified statement as to the deposits underlying the Judith River Beds.' I would say that the authorities for the Upper Cretaceous (and hence overlying) position of the Judith River Beds are partly cited in my recent memoir on 'The Vertebrata of the Mid-Cretaceous of the Northwest Territory,' namely, Cope ('Geology of the Judith River Basin,' 1876–7) and Cross ('Geology of the Denver Basin'). In his Cretaceous Correlation papers (U. S. Geol. Surv., 1891) C. A. White clearly refers the Judith River Beds to the Upper Cretaceous (pp. 145, 147); furthermore, the references which he makes to the Mid-Cretaceous Belly River deposits do not include any allusion to the typical Judith River, and distinctly state (p. 166) that the equivalent of these Belly River is not recognized in Montana. I thought I had, therefore, abundant authority for the statement, 'among geologists of the United States there has never been any question as to the Laramie or Upper Cretaceous age of the typical Judith River Beds.' I had received from Mr. Hatcher, but unfortunately had quite overlooked, his paper in which the Mid-Cretaceous age of the Judith River was first suggested. Otherwise due acknowledgment would have been made. In the last edition of his 'Geology,' published in 1895, and after complete review of the literature, Dana refers to the Judith River Beds as Upper Cretaceous, equivalent to the Laramie. It would be difficult to find higher authorities than these, and it is impossible, in the preparation of a memoir, to trace back every single statement to its original source; we must accept some authority, otherwise every statement requires a prolonged piece of original investigation.

Mr. Hatcher has done decided service in calling attention to the fact that in the original description of the *typical locality* Meek and Hayden left the actual relation of the Judith River Beds undetermined. Naturally it is this typical locality to which we must turn. It is, therefore, in view also of Professor Williston's communication, of the utmost importance that the vertebrate horizons of the Cretaceous should be thoroughly restudied. All critical notices and observations on this important geological problem are most welcome.

The following communication of this nature has been received from Mr. Sternberg, under date of December 11:

"I have been reading in Science Mr. J. B. Hatcher's correction of your statement in regard to the Fort Pierre and Fox Hills Groups, underlying the 'true Judith River Beds,' and

asking where you get the authority to make such a statement. I suppose Mr. Hatcher has never visited Dog Creek near the mouth of the Judith River, or read Professor Cope's paper on the Judith River region, with a cut illustrating this valley of Dog Creek. I was with the Professor when he made the sketch from which the illustration was made. I also know that the great bed of black shale filled with beds of soft coal was called Fort Pierre by Professor Cope, and that I found several bones of Mosasaurs in it resembling *Platecarpus*, that the buff-colored sandstone on top was called Fox Hills by Professor Cope. On top of these formations were the Judith River Beds, in which we found great numbers of the cast-off teeth of Dinosaurs. I there found the new ray *Myledaphus bipartitus* Cope, and many fragmentary shells of *Trionyx*, etc. On top of all was a bed of oysters. We got no complete bones, I believe, here of Dinosaurs. The two new species I found of *Monoclonius* were near Cow Island, about fifty miles down the river. I write for information. Is not Mr. Hatcher wrong in his correction? We found no Mosasaur bones in the vicinity of Cow Island. Would not the finding of these animals at Dog Creek prove the Fort Pierre age? We have similar deposits on top of the Niobrara in western Kansas that contain many Mosasaurs."

HENRY F. OSBORN.

A NEW DIVISION OF THE UNITED STATES GEOLOGICAL SURVEY.

A NEW division, to be known as the Division of Hydrology, has recently been organized by the Hydrographic Branch of the United States Geological Survey. The work of the division will include the gathering and filing of well records of all kinds, the study of artesian and other problems relating to underground waters, and to the investigation of the stratigraphy of the water-bearing and associated rocks. In addition to the gathering of statistics relating to the flow, cost, etc., of the wells, it is hoped in the future to give especial attention to the geological features which govern, or which are related in any way to, the supply of water.

The division will be subdivided into two sections, the eastern and the western, the first embracing the Gulf and Mississippi River states and the states to the east, and the second embracing the remaining ('reclamation') states and territories, or those having public lands. The charge of each section has been assigned to a geologist, the western section to Mr. N. H. Darton and the eastern section to Mr. M. L. Fuller. The office details are in charge of Mr. Fuller.

The sections will be still further subdivided, each state, or group of adjacent states, constituting a district, in which the work of collecting data and of the investigation of the problems relating to underground water will be in charge of a geologist employed for the purpose.

In the western section it is expected that the study of the geological structure will be followed by the sinking of wells by the survey, the aim being to test such of the arid or semi-arid regions as appear to present conditions favorable for artesian water, with a view to their ultimate development for agricultural purposes.

SCIENTIFIC NOTES AND NEWS.

DR. L. EMMETT HOLT, secretary of the board of directors of the Rockefeller Institute for Medical Research, has made a statement in regard to its plans. In addition to the $200,000 given by Mr. J. D. Rockefeller in 1901 for current uses, he has now given $1,000,000 for land and buildings, and it is understood that he is prepared to contribute such additional means as the needs of the institution demand. Dr. Simon Flexner, professor of pathology at the University of Pennsylvania has been elected director of the laboratory.

IT is reported in the daily papers that Mr. Marshall Field has offered to erect a museum on the Lake Front Park, Chicago, which may cost as much as $10,000,000.

A BILL has been introduced at Albany at the request of the State Commissioner of Lunacy, appropriating $300,000 for the con-

struction of a psychopathic hospital in New York city.

At the Founder's Day celebration of the University of Pennsylvania, the degree of D.Sc. was conferred on President Alex. C. Humphreys, of Stevens Institute of Technology. The address was made by Dr. S. Weir Mitchell.

Dr. E. A. Kennelly, of Harvard University, lectured on February 18 before the New York Electrical Society on the laying of the cable across the Gulf of Mexico.

Professor Charles A. Doremus, of the City College, New York city, lectured at the college on February 21 on the life and scientific work of Robert Bunsen. The lecture was given under the auspices of the Cooper Union Chemical Society.

John H. Barr, professor of machine design at Cornell University, is to become manager of the Smith Premier typewriter works at Syracuse.

The Executive Committee of the Illinois Wesleyan has granted Professor J. Culver Hartzell eighteen months leave of absence to pursue his investigation on conditions of fossilization in Germany. He sails from New York on March 18.

Reuter's agency states that Dr. Sven Hedin, the Swedish explorer, delivered a lecture on February 7, to the Geographical Society of Berlin upon his recent journeys in Central Asia and Tibet. During his lecture Dr. Sven Hedin gave some description of the Chinese writings he had discovered in a ruined city on the shores of Lake Lak-nor. The sinologist, Dr. Himle, of Wiesbaden, to whom they had been sent for translation, was of opinion that they pointed to the existence of a flourishing Chinese community about A. D. 250 on the spot marked by these ruins. At the conclusion of the lecture Professor Hillman announced that the German Emperor had conferred on Dr. Sven Hedin the second class with the star of the Prussian Order of the Crown. Dr. Sven Hedin was elected an honorary member of the Berlin Geographical Society, and was presented with the golden 'Nachtigal' medal which was founded in memory of a well-known Central African explorer.

Dr. George B. Shattuck, professor of physiographic geology of the Johns Hopkins University, and secretary of the Baltimore geographical Society, has been authorized by the directors to organize an expedition for a systematic scientific survey of the Bahama Islands.

Dr. F. B. Loomis, of Amherst College, will this summer conduct an expedition for the collection of fossils to the Bad Lands of South Dakota.

The Imperial Academy of Science of St. Petersburg will send an expedition to search for Baron Toll, who is exploring the Siberian coast line, and who was reported on November 21 to have been cut off from the coast by early winter ice in New Siberia. Lieut. Koltchak, who was with Baron Toll will command the expedition.

The Field Columbian Museum, Chicago, has arranged a course of lectures on science and travel for Saturday afternoons at three o'clock, as follows:

March 7—'The Crow Indians of Montana,' Mr. S. C. Simms, Assistant Curator, Division of Ethnology.

March 14—'Diamonds and Diamond Mining,' Professor O. C. Farrington, Curator, Department of Geology.

March 21—'The English Sparrow,' Dr. J. Rollin Slonaker, University of Chicago.

March 28—'A Tour of the Plant World—Japan,' Dr. C. F. Millspaugh, Curator, Department of Botany.

April 4—'Swimming Reptiles,' Dr. S. W. Williston, Associate Curator, Division of Paleontology.

April 11—'Mining in the Southern Appalachians,' Mr. Henry W. Nichols, Assistant Curator, Department of Geology.

April 18—'Our Household Insects,' Mr. W. J. Gerhard, Assistant Curator, Division of Entomology.

April 25—'Experimental Agriculture in Russia,' Mr. Frederick W. Taylor, Chief of the Department of Agriculture, St. Louis Exposition, 1904.

The medical papers of Ithaca state that the epidemic of typhoid fever at Ithaca has resulted in the death of ten students of Cornell University. Ten professors and instruct-

ors are ill with the fever. The epidemic is, however, now abating.

A CIVIL service examination will be held on March 10 for the position of aid in the Division of Mollusks, U. S. National Museum, with a salary of $1,000. On April 7 and 8 there will be an examination to fill positions as hydrographic aid in the U. S. Geological Survey, at salaries of $65 and $70 a month. It is stated that these appointees will be eligible for future promotion as assistant engineer after one or two years' service in the field.

WE learn from the *Electrical World* that at a meeting of the Fritz Memorial Committee, held in New York on January 23, the announcement was made that the four national engineering societies have appointed the following as their representatives on the board of trustees of the Fritz Medal: American Society of Civil Engineers, J. James R. Croes, New York, one-year term; Robert Moore, two-year term; Alfred Noble, New York, three-year term; Charles Warren Hunt, New York, four-year term. American Institute of Mining Engineers, E. E. Olcott, New York, one-year term; E. G. Spilsbury, New York, two-year term; James Douglas, New York, three-year term; Charles Kirchhoff, New York, four-year term. American Society of Mechanical Engineers, Gaetano Lanza, Boston, Mass., one-year term; John E. Sweet, Syracuse, N. Y., two-year term; Robert W. Hunt, Chicago, Ill., three-year term; S. T. Wellman, Cleveland, Ohio, four-year term. American Institute of Electrical Engineers, Arthur E. Kennelly, Cambridge, Mass., one-year term; Carl Hering, Philadelphia, Pa., two-year term; Charles P. Steinmetz, Schenectady, three-year term; Charles F. Scott, Pittsburgh, Pa., four-year term.

COMMANDER W. H. H. SOUTHERLAND, head of the Hydrographic Office of the Navy Department, contributes to the *National Geographic Magazine* for February an article defining the work of this great geographic bureau. At the present time the Hydrographic Office has in its possession nearly 1,200 engraved chart plates and about 50 photographic chart plates. These 1,250 plates have all been constructed from the results of original naval surveys; from geographical and cartographical data reported by the commanding officers of vessels in the naval service; from information collected by the branch hydrographic offices from incoming mariners of all nationalites, and also from the geographical information that comes into the custody of the Navy Department through the prosecution of surveys by foreign governments. These charts represent about one-third of what are actually necessary for a complete set of navigational charts of the world for the use of the naval and shipping interests of the United States. It must not be understood, however, that if we were to become possessed of engraved plates representing the charts now issued by all other nations we would be able to produce navigational charts covering the world's entire water area. Very much remains to be done before the hydrographic features of the world can be so chartered as to warrant the statement that dangers to navigation due to lack of knowledge of geographic positions and correct soundings have been reduced to a minimum. There are numerous places in the West Indies which we know to be inaccurately charted, and this same statement applies to locations in nearly all parts of the world. In the North Pacific Ocean alone there are thousands of reported dangers. Many of these are probably either inaccurately located or do not exist, but all the same they are a hindrance to navigation through the anxiety or loss of time which the fear of their possible existence causes to shipmasters. Fortunately, little by little the national vessels of the Great Powers are either accurately locating or disproving the existence of many of these.

As a result of an investigation along the Colorado River, made in January, 1902, by the hydrographic branch of the United States Geological Survey, the extent of the alluvial bottom land between Camp Mohave and Yuma was found to be from 400,000 to 500,000 acres. Extended surveys were begun November 1, last, to determine the area and quality of these

bottom lands, the possibility of diverting water to them, and the probable expense of their reclamation. The average rainfall at Camp Mohave is only 5.99 inches per annum, and at Yuma it is 3.06 inches per annum, while the temperatures are such as to provide twelve growing months in the year. The Colorado River derives its principal source of water supply from the melting snow on the high mountains of Utah, Colorado and Wyoming. It reaches the stage of maximum flow—approximately 50,000 cubic feet per second—in the months of May and June, when the demand for irrigation is normally the highest; its minimum flow—about 4,000 cubic feet per second—occurs in the months of January and February, at the time of least demand. The opportunities for storage on this stream are very great. The silts of the river are difficult to handle in canals, but the fertilizing properties which they have are such that lands irrigated with these muddy waters will never require further fertilization. Mr. R. H. Forbes, of the Agricultural Experiment Station at Tucson, Ariz., who has made a study of the silt in the Colorado River, has pointed out that this stream resembles the Nile in many particulars. Like the great river of Egypt, the Colorado is subject to an annual summer rise sufficient to overflow the extensive areas of its borders and delta lands. These high waters are rich in fertilizing sediments, are exceptionally free from alkaline salts, and come at an opportune time for irrigation. Mr. Forbes maintains that when the Colorado is understood and utilized as successfully as the greater and better-known Egyptian stream, it will be recognized as the American Nile—the creator of a new country for the irrigator, the mother of an occidental Egypt.

UNIVERSITY AND EDUCATIONAL NEWS.

By the will of the late Professor Sylvester Waterhouse, of St. Louis, Washington University received $25,000, and Harvard University and Dartmouth College each $5,000. The bequest to Washington University is to accumulate until the year 2000.

Sir William Macdonald, of Montreal, has donated a further sum of $4,500 to the Macdonald Institute at the Ontario Agricultural College, Guelph, to complete the furnishing. This makes a total of $175,000 given by Sir William to this institute.

S. M. Inman, of Atlanta, Ga., has given $25,000 toward the proposed presbyterian university to be erected in that city.

The new library building given to Trinity College at Durham, N. C., by Mr. James E. Duke, was formally opened on February 23. The dedicatory address was given by Mr. Walter H. Page of New York.

The Association of the Colleges and Preparatory Schools of the Middle States and Maryland will hold its next annual meeting at Columbia University, November 27 and 28.

At the mid-winter commencement of the University of Nebraska, on February 16, 1903, degrees were conferred as follows: Bachelors of Arts, 17; Bachelors of Science, 7; Doctor of Medicine, 1; Master of Arts, 1; Doctor of Philosophy, 1. Eleven graduates were given University Teachers' certificates. The thesis presented by the candidate for the degree of Doctor of Philosophy, Haven Metcalf, was in botany, and consisted of a discussion of the cause and nature of a disease of sugar-beets, to which the name of 'sour rot' has been applied.

The chair of physiology at the Harvard Medical School, occupied by Professor H. P. Bowditch, will hereafter be known as the George Higginson Professorship.

Dr. George B. Halsted, late of the University of Texas, has been elected to the chair of mathematics of St. John's College, Annapolis, Md., to succeed Professor John L. Chew.

Dr. Alexander Johnson, dean of the faculty of arts and professor of pure mathematics, and the Rev. Dr. J. Clark Murray, professor of mental and moral philosophy, have resigned their appointments at McGill University, to take effect September 1, 1903. They retire in accordance with the pension scheme formulated last year by the board of governors.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 6, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*INAUGURAL ADDRESS OF THE PRESIDENT OF THE STEVENS INSTITUTE OF TECHNOLOGY.**

IN subscribing to this oath of office I am profoundly sensible of the responsibilities I assume.

For the two months preceding my acceptance of the presidency of Stevens Institute I was constantly studying the many questions involved therein, and especially that of my fitness for the office. I feared that it would be presumptuous for a man not an educator by profession to undertake to carry on Dr. Morton's great work; at the best it seemed to me an experiment of doubtful wisdom, for failure meant probable injury to the loved *alma mater* as the return for serious sacrifices to be made by myself and those dear to me.

In considering the objection that I had not been trained as an educator, I was not unmindful, on the other hand, of the fact that in my professional career I had been called to direct the later studies of graduates of engineering schools, including a large number of Stevens men, and so had been forced to study and appraise from the viewpoint of practice, the efficiency of the training supplied by a number of our technical schools. In this work I had found myself deeply interested; and in reviewing my experiences in this and some other di-

* Delivered in the Carnegie Laboratory of Engineering, February 5, 1903.

rections in which I had been brought into practical contact with educational work, I was encouraged to hope that if I accepted this office my lack of training and experience in the school might in part be compensated for by these experiences and my sympathy with the aspirations of youth.

Finally my action was determined by the fact that the call was made by the trustees, faculty, alumni association and many of the alumni individually.

Since I have been in daily contact with the duties and responsibilities of the office I have been more and more impressed with the largeness of my undertaking and with the practically unlimited opportunities afforded for the exercise of a wise, patient, firm and energetic leadership.

As all this and more is included in my view of the situation, necessarily then I am profoundly sensible of my new responsibilities. But I must ask those at whose instance I have accepted this office to understand that they have not shifted their responsibilities to my shoulders. I shall look to them to help me to carry my new burdens and to be patient with me when I hesitate or stumble on the way.

As the circumstances under which I have accepted office are somewhat unusual, I have, at the risk of being misunderstood, decided to thus briefly refer to some of the influences under which I have acted.

The responsibility rests upon us all—trustees, faculty and alumni—to preserve and further extend and perfect that which has been so well built on the noble benefaction of E. A. Stevens. The admirable record which has been made during the thirty years of Dr. Morton's brilliant, wise and self-sacrificing administration will not alone carry the institute over the obstacles surely to be met in the years to come.

This reference to the work of our honored late president leads me to recall with a reverent sense of appreciation the devoted services of Professors Wood, Mayer and Leeds, who are with him now resting from their labors.

While resolving to zealously preserve and develop that which has been passed on for a while to our stewardship, let us consider whether this calls for any departure from the established ways. My four months' experience as acting president, added to that gained as alumnus, trustee, engineer and man of business, leads me to say emphatically that though there is much to be done, there is no change in principle or policy to be desired or tolerated.

The changes to be made are chiefly those called for by the increase in the number of students. A glance at the register shows that the equipment, methods and administration of twenty years ago are no longer adequate to meet our present requirements. Even with his own repeated benefactions Dr. Morton was unable to keep pace with the requirements as they developed.

The first ten classes graduated numbered as follows:

'73, 1; '74, 3; '75, 10; '76, 17; '77, 10; '78, 22; '79, 14; '80, 9; '81, 17; '82, 14. Total for first ten years, 117.

The last ten classes graduated numbered as follows:

'93, 43; '94, 39; '95, 45; '96, 64; '97, 63; '98, 57; '99, 53; 1900, 53; 1901, 40; 1902, 54. Total for last ten years, 511.

There have been 987 graduated up to date, of whom 54 have passed on to that other life where their records as engineers are only of moment as affecting their records as men.

These figures alone do not furnish a fair comparison and should be supplemented by a comparison of enrollments.

The enrollment at the end of the first ten-years period was:

Freshmen	53
Sophomores	47

Juniors	20
Seniors	12
Total	132

and the enrollment at the end of the last ten-years period was:

Freshmen	87
Sophomores	78
Juniors	48
Seniors	55
Total	268

The enrollment at the beginning of this school year was:

Freshmen	115
Sophomores	69
Juniors	62
Seniors	50
Total	296

Though by these last comparisons it appears that we have only something more than double the number of students to care for than we had twenty years ago, the practical facts are that in our upper classes we have nearly five times as many to instruct; and, as most of our class- and lecture-rooms can accommodate only about fifty students, the lower classes have to be taught in sections, requiring the professors and instructors to duplicate much of their work.

This all means that we need larger class- and lecture-rooms, larger chemical and physical laboratories and shops, a general auditorium, additional equipment and additional instructors.

Another addition, which should be made, is at least one dormitory.

To complete our course in four years requires of the students hard work and long hours. It is thus incumbent on us to do our utmost to keep the students in good working condition, mentally and physically.

To this end they should have cheerful, comfortable, sanitary, though simple, lodgings, and plain, wholesome and attractive food. Men so cared for and provided with facilities for intelligent recreation should be able to safely undertake a large amount of work, and should be less liable to seek relaxation in harmful pleasures.

I am most anxious to promptly secure such an addition to our plant as will enable us to offer these more attractive and elevating surroundings to those of our students who in coming to us are cut off from home influences.

This would add to the cares and responsibilities of the administrative officers, but it would also give us additional opportunities to influence the students for good.

It would also tend to cultivate a healthier college spirit and to attract more men from the several sections of the country, which would in itself be broadening and mellowing to the student body.

On the basis of the present fees for instruction the original Stevens endowment was at first ample to furnish the additional income required to meet the difference between the yearly expenses and the income from students. That difference now amounts to about $100 per year per student. The original endowment would now be entirely inadequate to meet our developed requirements, and even with the additions made by Dr. Morton from time to time, aggregating $150,000, the Carnegie Laboratory and its special endowment of $100,000, $30,000 given at the time of our twenty-fifth anniversary by Mrs. E. A. Stevens, Sr., and other additions by members of the Stevens family, our endowment is insufficient to meet present needs, to say nothing of the additions required to be made to our plant and our teaching staff as already outlined. Expenditures which the trustees, upon my earnest recommendation, have already authorized lead me to fear a deficit at the end of this school year. Against this it is encouraging to note that provision is already being made to meet some of the deficiencies in our plant.

Before Dr. Morton's death $60,000 had been subscribed by him and the alumni for a laboratory of chemistry. This amount proves under present market conditions insufficient for the purpose, and I am now applying to the alumni—and the alumni alone—for an additional $60,000 to enable us to build and thoroughly equip a laboratory which will equal, if not surpass, in practical efficiency anything of the kind in the world. This is a large additional sum to ask from such a small body of men, the majority of whom are young and working on salaries; but if we succeed—as I believe we shall—this addition is to be named the Morton Laboratory of Chemistry, and it will serve as a most fitting memorial of our late president.

In moving into the Carnegie Laboratory of Engineering we set free the ground floor of the main building. At comparatively small expense this can be arranged to afford an excellent location for larger and more efficient shops. Moving the shops from their present location would set free the old auditorium, which with certain changes and additions could be restored to its original purpose and provide for an audience of seven hundred. This change, including some additional tools and certain other minor, but much-needed, additions to our plant, could be effected for a cost not to exceed $25,000; part of this has been subscribed contingent upon the whole sum being pledged.

One important step has been taken towards the beginning of dormitory life. Col. E. A. Stevens, our trustee, and his brother Robert L., sons of our founder, have notified me that a piece of land, 200 x 100 feet, which they jointly own in the block adjoining the institute's property, admirably located for the purpose, will be deeded to the Institute provided we can promptly erect thereon a dormitory. Preliminary plans have been drawn for a group of three buildings, which can be erected separately or together, as circumstances demand or warrant. One of these buildings would contain a refectory to cater to all the students lodged in the three buildings. Each unit in this group could be well made to serve as a separate memorial and named accordingly. I believe the cost of one of these units could be quickly pledged if pledges for the other two could be obtained. The entire group would accommodate about 110 students, and would be sufficient for our present needs.

This would not only greatly increase the efficiency of our plant, but would considerably add to our income.

What I have said will serve to correct the opinion held by many that our endowment is sufficient for our needs. There are some who know more or less completely of those needs, but hold, as I believe, a totally unwarranted opinion as to where we should look for relief. After considering the question long and carefully, I have decided to openly combat this opinion: namely, that as the institute carries the name of Stevens, the heirs of E. A. Stevens should be responsible for its support. This strikes me as a most unjust proposition.

E. A. Stevens bequeathed $650,000 and a block of land for an institution of learning. So well has this trust been administered that a new line of educational work has been developed, and the success achieved has created the demand for the increased facilities I have just mentioned.

Because the world has secured through the original endowment so much more than could have been reasonably anticipated, does that furnish a reason for demanding from the heirs of our founder, after the balance of his fortune has been divided into many parts, that they keep pace with this

constantly increasing financial requirement by constant additions to our endowment?

Rather, it seems to me, that because of the great work accomplished primarily through the instrumentality of the Stevens endowment, the community and those who have directly and indirectly profited by the advances made in technical education during the last thirty years—and it would be hard to find in the United States those who have not so profited—owe it to E. A. Stevens, his heirs, Dr. Morton and those who as trustees and instructors have faithfully worked with him, to provide the means to maintain, extend and perfect that which is already a powerful agency for good.

I have gone so far in speaking on a somewhat delicate subject, I may as well go farther in the hope of disposing of this question once for all.

It has been further suggested, that as the institute carries a family name, we have but little chance of securing aid from sources outside of that family. I do not doubt that this may influence some narrow-minded men against coming to our relief. But we can show against this that it has not stayed the helping hands of Henry Morton and Andrew Carnegie.

The evidences are on every side that our rich men are exercising more intelligent discrimination in the effort to secure full returns on their philanthropic investments. As with their personal investments, they are coming to investigate in advance, to make as sure as possible that their benefactions will secure full returns in perpetuity. To such a man it could be readily shown that a million dollars added to our present endowment and plant, would give a far greater return than could possibly be derived from the same amount employed to establish a new institution.

And now why should not the name of 'Stevens' be attached to our institution? Our original endowment was a large one for the time when it was made, and it was most natural that the institute should have been named after our founder, though it is a fact that some of the family opposed that course. I can say that, while in my opinion any change would be most unwise, the Stevens family would be the first to urge a change if they believed that a majority of the alumni were in favor of it, or if by so doing we could secure the cooperation which would enable us to enlarge our usefulness. But it can not be supposed that the alumni would be willing to surrender the prestige which is theirs through being known as graduates of Stevens.

If we must consider the question of name, it should be seen that we offer an advantage rather than otherwise. Such an addition to our endowment as I have spoken of would be naturally individualized under the name of the donor. That name would not be alone, but would stand with the three great names—Stevens, Carnegie, Morton—and this should attract rather than repel.

In estimating our future requirements we should not fail to recognize that there has been within the last few years a marked increase in the demand for technically educated men. It is beginning to be recognized that the commanding position which the United States to-day holds in the fields of industry and commerce, is in considerable measure due to the intelligent and conscientious work done during the last thirty years by our technical schools.

While our country has benefited by a unique combination of natural advantages, it needed the men technically educated, working in an atmosphere most favorable to the full utilization of their best powers, to secure from these conditions the exceptional prosperity of to-day.

We can better appreciate our advantages, both as to superiority in the line of

technical education and freedom from the trammels of caste, when we compare our condition in these regards with that of Great Britain; yes, and even with that of Germany.

This increase in the demand for scientifically trained engineers is evidenced by the fact that whereas thirty, and even ten, years ago employers could select from the graduating classes to meet their requirements, to-day many concerns now accept these graduates and apply for them a year in advance, without being able to exercise any such selection. This has resulted in creating some question in the minds of certain employers as to whether our methods are now as efficient as in the past. Naturally they find that the cadet engineers they now hire without the advantages of selection do not average as high as those engaged in years gone by.

This does not at all mean that every young man must succeed because he is a graduate of Stevens or some other good engineering school. It only means that his diploma will give him the opportunity to prove the stuff of which he is made.

Since Stevens Institute was opened many new engineering schools have been organized, and the departments of applied science in many of our universities have been so developed and improved that they have in some cases become the very life of the universities with which they are connected.

As we contemplate this change we may be tempted to question whether our little school has a work to perform which can not be safely left to others. Then let us remember how many there are in this vast and growing country requiring, for the nation's good, to be educated in applied science. In thirty years Stevens has placed less than one thousand men in the industrial ranks. There is room and more than room for all of these schools, and we may well wish them all Godspeed.

If some time in the future it were found that there were more than enough technical schools to supply the wants of this great country, the country should be the gainer, for the fittest only would survive. And if under this searching test it were found that we were unable to show a reason for our continued existence, we could at least take comfort from the reflection that we had helped in no mean degree to make possible the progress in educational methods with which we had finally been unable to keep pace.

But I prefer to believe that, let the standard be developed never so high, Stevens will be found steadily in the van.

In the past there has been a tendency in our technical schools to specialize too closely. Graduates of technical schools are sometimes to be heard regretting that they had not first taken a B.A. course. Part of this is no doubt a well-grounded regret occasioned by a too narrow training, but part of it is the natural inclination we all experience to long for that we do not possess, and lightly regard that we have grown familiar with through years of use. No doubt every possible effort should be made to include in the engineer-student's curriculum all that the four years will safely contain of such non-technical studies as will be best qualified to make the course broad as a whole. But let us be careful that the reaction from the fault of too close specialization does not carry us to the other extreme.

First our students should be thoroughly and completely trained in the fundamentals required in the practice of their profession. They must be given a *working* knowledge of the higher mathematics and an accurate knowledge of the fundamental laws of nature; and throughout the course they must be trained to apply in the drawing-room, the shops and laboratories, the mathematics, chemistry and physics (espe-

cially mechanics and electricity) learned in the lecture- and class-rooms.

That is to say, there must be as complete a coordination of theory and practice as is possible in an institution of learning.

The tremendous activity in the industrial field creates a constant pressure for the inclusion in our course of closer specializations within our specialty. As our course is now so crowded that no additional work can be safely included without the elimination of an equal amount, this pressure, if not resisted, will almost surely result in the slighting of the essential fundamentals.

As in the past we have stood for the harmony of theory and practice and thoroughness, so we have stood for concentration on one broad course in mechanical engineering. While we have thus differentiated from the other broader divisions of the engineering profession, such as civil, mining and electrical, we have covered much that is included in these other divisions.

In any case we can not expect to graduate our men as engineers. As they get out in the world probably natural bent or necessity will lead most of them to further specialize. If so and they have taken advantage of the opportunities we have offered them and even forced upon them, they will find they are able to quickly and surely build upon the broad and strong foundations they have here laid.

There are certain studies which can not be properly or safely omitted from any engineering course, be it mechanical, civil, mining, electrical or any other. I should include in this list English, logic, history, modern languages, economics and business methods.

Outside of the question of culture, an engineer needs a working knowledge of his own language. He must be able to convey to his employers or associates in language concise and explicit the results of his work or investigations.

In the department of economics he should at least have sufficient insight into the science to guard himself against the danger of drawing conclusions from insufficient or inconsistent data.

He should have such a knowledge of business methods, and especially the principles of accounting, as to qualify him to exercise a close and independent supervision of manufacturing cost. He must appreciate the necessity for and be capable of instituting a system of charges, based upon a complete study of local conditions, to provide for the depreciation of plant and stock; he must appreciate the danger of confusing capital or investment items with revenue or expense items.

While we can not expect to give the engineer-student a working knowledge of the law of contracts, we should try to give him such instruction as will serve to warn him of the pitfalls to be avoided, and to impress him with the wisdom of seeking competent legal advice in all cases outside of established routine.

All this and more must be covered in a course which claims to harmonize theory and practice, for the engineer who is most practical in the shop may be most unpractical in business affairs—and here it is to be understood that the engineer must find his success within the limitations of commercial conditions.

Much of this part of the instruction may well be included in lectures on engineering practice, and preferably these lectures should be delivered by men who have themselves been successful as engineers and speak from that standpoint; for it is most difficult to impress upon students the necessity for the inclusion of these subjects in a course of engineering study. This applies particularly to the study of English, and every possible effort should be made to

quickly impress upon the freshman classes the reason why English is necessarily included in the curriculum; unless the sympathy of the students can be promptly secured in connection with this difficult study, there is but little hope that much good can be accomplished in the time available.

To do in four years all the work which has been here most briefly outlined the student should be strong mentally and physically and be possessed of a definite purpose.

There is danger of overstrain, but I firmly believe the danger of injury is less than in the case of the courses in some of our universities, where, according to our own observation, confirmed by the views lately expressed by a number of the university presidents, the students can take their B.A. degree in four years without any sustained effort. This is an enervating influence to which many young men can not safely be subjected. Our students are better able to sustain the strain to which we subject them because they average in years somewhat higher than those entering the universities for the first degree. Our last three classes averaged, respectively, at entrance, 18½ years, 18⅓ years and 18¾ years; a general average of say 18½ years.

This brings the average age of the graduate to more than 22½ years, as there are more of the younger students than the older who drop by the way.

This should dispose of the question of lengthening the course to five years, except in the case of the few who are specially qualified to carry on work in engineering research.

There can be no question that during the next decade we are to see many changes in our educational methods. We must here be prepared to listen to all suggestions with an open mind, and then be careful not to act rashly. During the last quarter century there have been in the United States not a few false moves made in our educational schemes, and especially has there been a tendency at times to spread out thin at the expense of thoroughness.

In looking over the list of our alumni and the work they have performed and are now performing, we can obtain therefrom enough encouragement to warrant us in moving slowly when radically different methods are suggested for our adoption.

When we think of these changes to come we may well hearten ourselves by recalling that many of our great universities and important colleges and separate technical schools are under the direction of men who are statesmen as well as scholars.

While it is our duty as teachers and guides to see to it first that the men entrusted to us should be producers and not dependents, that the problem of self-support should first be honestly and squarely met, we should further endeavor to cultivate in them aspirations for the higher things of this life and the life to come.

The motive for the struggle for success may at first be largely selfish, but, as we all can acknowledge with gratitude, from lower motives can be evolved those of a higher order.

While we of the faculty can not give our students religious training, we can be careful to set them an example of absolute honesty and straightforwardness. We can best eliminate meanness and trickiness from the student body by being ourselves candid, just and, as far as our natures will permit, sympathetic. We may well recall the names of the headmasters of certain schools whose influence upon the lives of their scholars has been potent to the end. It was not the curriculum or the system of teaching which made these schools so effective for good, but the personal influence of these men who were deeply sensible of the responsibility

of being entrusted with these young lives during the formative period.

Even in a school like ours the faculty can exert a strong personal influence for good and can, if they will, create an atmosphere of honesty which should be of special benefit to the students in connection with that vexed question of examinations. The responsibility for honest examinations first rests on the examiners. And we must remember that the man who is not honest in the class-room defrauds his *alma mater* and weakens and debauches his own character.

God grant that such an influence shall always be around the students of Stevens, and that so they may go out into the world not only honestly trained to take their places in the engineering profession, but also influenced to do their whole duty as citizens and self-respecting, God-fearing gentlemen.

ALEX. C. HUMPHREYS.

THE SOCIETY OF AMERICAN BACTERIOLOGISTS.

THE fourth annual meeting of the society was held at the Columbian University Medical School, Washington, D. C., on December 30, 31, 1902. Abstracts of papers* presented at the sessions of the society follow herewith:

Contribution to the Study of Agglutinins: W. W. FORD and J. T. HALSEY. (From the Pathological Laboratory, John Hopkins University.)

Experiments were undertaken to determine which constituent of the red blood corpuscle takes part in the production of lysins and agglutinins when the blood of one species of animal is used to immunize another species, Bordet stating that the stroma was responsible for the lysins, Nolf maintaining that the stroma was responsible for the agglutinins, the laked blood for the lysins. In the present experiments rabbits and guinea-pigs were immunized with the stroma and the laked blood of hens; guinea-pigs with the stroma and laked blood of rabbits; rabbits with the stroma, the laked blood, and the washings from the stroma, of the goose; and rabbits and guinea-pigs with the hæmoglobin of hens' and dogs' blood.

For the preparation of the stroma and the laked blood, the blood was washed with isotonic salt solution, laked with two to three times its bulk of water, made up to one per cent. salt solution, and centrifugalized to separate stroma from aqueous solution. Stroma was then washed repeatedly with water made up to one per cent. salt solution or with isotonic salt solution.

For the preparation of hæmoglobin the blood was collected in ammonium oxalate, washed, laked with distilled water, centrifugalized to get rid of the stroma, treated with 25 per cent. absolute alcohol, upon the addition of which the crystals of oxyhæmoglobin are deposited at 0° Centigrade. The dog's hæmoglobin crystallizes readily, the hen's hæmoglobin with some difficulty.

The results of the experiments showed that in all cases the animals immunized with the laked blood and the stroma from rabbits and from hens developed in their sera agglutinins and lysins both far beyond the limits of normal variation, so powerful that frequently in dilutions of 1–100, always in dilutions of 1–50, complete agglutination and lysis took place. The rabbits immunized with goose's blood stroma and aqueous solutions developed agglutinins only—no lysis taking place. The agglutinins were present in very high dilutions, at times 1–10,000, always in dilutions of 1–1,000. Normal rabbit's serum agglutinates goose's blood in dilutions of 1–250 or 1–330. The attempt to supply a complement for a hypothetical amboceptor

* The abstracts were prepared by the authors.

with hen's, rabbit's and guinea-pig's sera was unsuccessful. The animals immunized with dog's hæmoglobin possessed, after repeated injections, a serum not differing from the normal, while the animals treated with hen's hæmoglobin developed agglutinins and lysins present in dilutions of 1–100 parts.

On the Nature of 'Pyocyanolysin': E. O. JORDAN, University of Chicago.

A number of bacteria, including pathogenic forms like the tetanus bacillus, and ordinary saprophytes like *B. megatherium,* have been reported as producing hæmolysins in their broth cultures. *B. pyocyaneus* is one of these forms, and 'pyocyanolysin' has been generally considered as belonging in the same general category with tetanolysin and staphylolysin.

The well-known laking effect of alkalies and the fact that old cultures of *B. pyocyaneus* possess a strongly alkaline reaction led to inquiry into the relation between the alkalinity of the bacterial filtrate and the power of the filtrate to produce hæmolysis. It was found that the filtrates from broth cultures of *B. pyocyaneus* (seven strains, one freshly isolated and quite virulent) produced no greater hæmolysis than NaCl solution, or sterile broth of the same degree of alkalinity. The alkalinity of *B. pyocyaneus* filtrate sometimes reaches as high as 2.6 per cent. normal alkali. If the alkalinity of the *B. pyocyaneus* filtrate be increased or diminished, the hæmolyzing power is correspondingly affected. The hæmolytic power is practically destroyed by neutralization (indicator, phenolphthalein). Most bacterial hæmolysins, like the hæmolysins of blood sera, are inactivated by exposure to a temperature of 56°; but 'pyocyanolysin' will withstand 125° for at least an hour. The statements regarding 'pyocyanolysin' made by Bullock and Hunter, Weingeroff, Breymann and Loew indicate that the hæmolyzing power observed by these writers in the filtrate of *B. pyocyaneus* is no greater than might be due to the simple alkalinity of the medium. It is possible that other strains of *B. pyocyaneus* may be found which produce some other hæmolysin than alkali, but it is evident that in any study of bacterial hæmolysins the superimposition of the effect of alkali upon that of any other hæmolyzing substance must be reckoned with, especially when corpuscles so sensitive to alkali as those of the dog are used for test objects.

A Fat-splitting Torula Yeast Isolated from Canned Butter: L. A. ROGERS, Biochemic Laboratory, Washington, D. C.

The author has isolated from several samples of canned butter, a torula yeast, possessing to a limited degree, the ability to split up glycerides with the liberation of free fatty acid. The action of this torula is much weaker than that of the fat-splitting molds.

The acid number of a pure butter fat inoculated with a milk culture of the torula, increased in two weeks from 0.579 to 3.474.

The cells are elliptical, about 3.5 μ long and have little tendency to form chains or bunches.

The yeast ferments maltose slowly at 37° C., but does not ferment lactose, galactose, levulose, mannose or cane sugar.

A complete description will be given in a later paper.

Oligonitrophilic Bacteria of the Soil: FREDERICK D. CHESTER, Delaware Agricultural Experiment Station.

Reference is given to the early literature bearing upon the subject of nitrogen assimilation by lichens, aerophilous algæ, molds and bacteria.

Land may gain in nitrogen through the activities of soil bacteria. Oligonitrophilic

bacteria are those that grow in nitrogen-free or nitrogen-poor media, and that possess the power of utilizing the free nitrogen of the air. The oligonitrophiles belong to the *Clostridium* group, or to Beijerinck's *Granulobacter* group.

Clostridium Pasteurianum, which Winogradsky found to possess nitrogen-assimilating properties, is an anaerobe, but it also grows in symbiosis with aerobic forms; it is, therefore microaerophilic. The microaerophiles will grow luxuriantly under normal conditions under diminished oxygen pressure, effected by the active utilization of oxygen by the aerobes (macroaerophiles).

Nitrogen assimilation in the soil is not the result of the activities of a single organism, but of symbiosis of microaerophiles with macroaerophiles. Of the microaerophiles we have *Clostridium Pasteurianum,* several species of *Granulobacter* of Beijerinck, and *Radiobacter* of Beijerinck. Of the macroaerophiles we have *Azotobacter* of Beijerinck.

Azotobacter alone is without nitrogen-assimilating properties, and the same is true of the *Granulobacter* and *Radiobacter,* but mixed cultures of *Azotobacter* with the other forms showed marked gain of nitrogen of four to seven milligrams per gram of assimilated sugar in the medium. A form of *Azotobacter* isolated from Delaware soil was without the power of assimilating atmospheric nitrogen.

The Bacterial Flora of the Oyster's Intestine: CALEB A. FULLER, Brown University.

Of late there has been considerable difference of opinion regarding the significance of *B. coli* in drinking water and various foodstuffs. Some authorities do not consider this organism a certain indication of sewage pollution, while others look with suspicion on all food materials containing bacteria of the colon group. Oysters are especially liable to contamination by sewage, for many cities and towns discharge their waste matters into bays or other bodies of water where they are cultivated.

In some reports on the bacteriology of the oyster it was suggested that *B. coli* might be present normally in the intestines of oysters. This statement differs materially from the results of some previous work of mine on oysters and sewage in Narragansett Bay. These results seem to indicate that this organism does not occur in oysters obtained from perfectly clean sea-water. In order to throw some light on this point I examined the intestines of over two hundred oysters in October and November, 1902. These oysters were taken from a bed known to be free from any trace of sewage. A number of tests have shown that the sea-water above this bed does not contain *B. coli.*

The method of analysis was as follows: Two gelatin plates were inoculated, each with a large loop of material from the intestine of each oyster and grown at room temperature for three or four days. One of these plates was made from the usual nutrient gelatin and the second from gelatin containing carbolic acid (.05 per cent.). From the ordinary gelatin plates I separated sixteen species of bacteria; some of them common water forms, and others unidentified, that seem to be characteristic of the oysters of this locality. Of the carbol-gelatin plates, with but a single exception all remained sterile. The single colony that developed was not *B. coli.* If *B. coli* was present in the intestines of these oysters, even in small numbers, it would have developed in the above medium. Of the other species isolated, none resembled *B. coli* when tested by the usual methods.

From the results of these experiments it appears that the colon bacillus is not normally present in the intestines of oysters, and when present always indicates contamination from some outside source.

The Influence of Physical Conditions on the Character of Colonies on Gelatin Plates: A Preliminary Communication: EDWARD K. DUNHAM, New York University and Bellevue Hospital Medical College, New York.

Attention was called to the influence of physical conditions on the appearance of colonies by two sets of observations: (1) The same species of bacterium grown in different lots of gelatin made with the same ingredients and having the same reaction frequently produced colonies of widely divergent appearances; (2) colonies of different species often form colonies that are indistinguishable in some gelatins, but when grown in other lots of gelatin can be readily recognized as different. These variations were traced to differences in the stiffness of the gelatins, and this led to a study of the physical properties of nutrient gelatin. The melting points, penetrabilities and viscosities were determined and compared with the appearance of colonies on plates made with the gelatins. Attention was chiefly directed to the deep colonies, and the studies were confined to the colon bacillus, bacillus typhosus, bacillus dysenteriæ and a paratyphoid bacillus.

If the gelatin is very stiff the colon colony is lenticular in form and presents a tendency to form multicontours. In a somewhat softer gelatin the colony is spherical, with indications of concentric structure. In still softer gelatin, budding or root-like projections are formed on the surface. In a very soft medium, not a single colony but a federation of colonies, closely grouped together, is produced. Similar variations occur when typhoid colonies develop on plates. These may be small and spherical, or more or less thready with delicate filaments penetrating into the medium, according to whether the gelatin is stiff or relatively soft. In a very soft but still solid gelatin, the typhoid bacilli may penetrate the medium, disseminating themselves throughout its mass. Such plates appear sterile.

Variations in the stiffness of the gelatin may be produced by a reduction of its original stiffness with heat or by incubating the plates at different temperatures. A ten per cent. gelatin made with Compte Fils's or Heinrich's 'Gold Label' gelatin, cooked with an egg for thirty minutes and sterilized three times for fifteen minutes in the Arnold sterilizer, will melt at 29.5° to 30.3° and have a viscosity between eight and nine times that of water. Gelatin plates made with this gelatin and incubated at 27° will yield, *e. g.*, colon and typhoid colonies that can easily be distinguished from each other and fished within twenty-two hours.

In the author's opinion the physical properties of gelatin and temperature of incubation should receive fully as much attention as the ingredients and reaction in the standardization and use of gelatin, particularly when employed for plating with reference to species.

Milk-agar as a Medium for Demonstrating the Production of Proteolytic Enzymes: E. G. HASTINGS, University of Wisconsin.

If ten to twelve per cent. of sterile skim milk is added to ordinary nutrient agar, after the same has been allowed to cool to 50° C. after having been melted, an opaque medium is obtained which, when allowed to solidify in tubes in a sloping position, or poured into Petri dishes, has some advantages over gelatin for the determination of the liquefying properties of bacteria,

inasmuch as it can be incubated at high temperatures.

If cultures of a liquefying organism be made in this medium, the growth after a few hours' incubation will be surrounded by a transparent zone due to the liquefaction of the casein.

Its advantages over gelatin are that it can be incubated at any temperature; that the liquefying power of organisms whose optimum temperature zone lies above 20° C. can be determined in a much shorter time than by the use of gelatin.

It can also be used to determine the presence of proteolytic enzymes in plant and animal tissues by adding cubes of milk-agar to the extracts of such tissues, in the presence of suitable antiseptics, such as small amounts of carbolic acid or formalin. The presence of proteolytic enzymes is made apparent by the edges of the cubes becoming transparent.

Laboratory Notes: W. M. ESTEN, Middletown, Conn.

A new thermo-regulator for incubators heated with incandescent lamps was constructed from a description by Mr. H. E. Ward, of the Illinois Experiment Station. This was shown and its regulating quality demonstrated. Its advantages are that the heat is applied to the interior, and that incubators can be constructed of wood and danger from fire avoided.

New Method of Preparing Blue-litmus-lactose-gelatin.—The cooking and sterilizing of litmus with gelatin proves to be detrimental to the reaction of litmus. The litmus and gelatin media are prepared and sterilized separately, then mixed immediately before plating. Fifteen to twenty per cent. of litmus is digested in distilled water for several hours at 70° C., filtered, the reaction adjusted to + 1.5 per cent., and sterilized. A gelatin medium is prepared with 3 per cent. lactose and 25 per cent. less water than ordinary gelatin. Tubes are filled with 8 c.c. of gelatin.

Cheese-whey-gelatin is prepared by adding rennet to fresh skim milk. The whey is placed in an autoclave for thirty minutes at 105° C. Ten or eleven per cent. of gelatin is added and the medium cooked in open dish until one-fourth is evaporated; the reaction is adjusted to + 1.5 per cent., and tubes filled with 8 c.c.

To prepare the gelatin tubes for plate cultures, place in each tube of melted gelatin with sterile pipette 2 c.c. of the litmus solution, mix and add 1 c.c. of diluted milk, and plate.

The comparative values of the two kinds of gelatin are that the lactose-litmus-gelatin gives the maximum numbers while the cheese-whey-litmus-gelatin gives a strong differentiation of acid and non-acid species. To get the advantages of both kinds of gelatin mixing half and half proves very satisfactory.

It is possible by means of this mixed gelatin to classify the different kinds of bacteria on the plates by means of the colonies alone.

The 'Germicidal Property' of Milk: W. A. STOCKING, JR., Middletown, Conn.

Freudenreich, Park, Hunziker and others have shown that cows' milk, when a few hours old, contains a smaller number of bacteria than when freshly drawn from the cow. From this they conclude that milk possesses a 'germicidal property or action' during the first few hours. This conclusion was based on the results obtained from agar plate cultures, on which the total numbers of bacteria were determined. These investigators, however, were unable to explain the cause of this phenomenon. The purpose of the experiments described in this paper was to determine, if possible, the cause of this dropping out of the organ-

isms during the early part of the ripening period. For this work peptone-litmus-gelatin was used and the milk was plated at intervals of three hours. From these plates the total number of organisms, the number of acid-producing bacteria and the different species, as far as possible, were determined. The results of a long series of experiments seem to show that the decrease in numbers was due, not to any 'property or action' possessed by the milk, but to the natural dropping out of certain species of bacteria which do not find the milk a suitable medium in which to grow.

Fresh milk obtained under ordinary conditions contains a large variety of types and species of bacteria, while milk which has soured or curdled contains but few species, often not more than two or three. Fresh milk ordinarily contains but few of the typical lactic organisms which later cause souring and coagulation. When these species have once gained access to the milk their growth is constant and quite uniform from the first. Certain other acid-producing species, however, and many non-acid species do not find the milk a favorable medium in which to grow, and drop out. Some species appear only in the plates made from the fresh milk, while other species may continue for a few hours and then disappear. Usually the decrease in the numbers of the miscellaneous species is greater than the increase in the 'lactic' species, during the first few hours, so that plate cultures made when the milk is a few hours old will show smaller numbers of bacteria than were found in the fresh milk.

Summary of the Steps which must be Followed in Staining Flagella by Löffler's Method: W. R. Copeland, Bureau of Filtration, Philadelphia, Pa.

The films of bacteria on the cover slips should be made from suspensions of bacteria obtained by immersing the cells in water for one or two hours in order to dissolve the outside gelatinous capsule.

Löffler's mordant should be made of the best grade of tannic acid with ferrous sulphate and Gruebler's basic fuchsin. This mordant should be heated to 70° or 75° C., until a stream of steam rises for a distance of two inches. The preparation should then be set aside for half a minute. The stain is made of the best grade of aniline oil, absolute alcohol and a saturated alcoholic solution of Gruebler's basic fuchsin. The stain should be applied cold, for from eight to ten seconds.

Finally Löffler's method of staining flagella is better and more powerful than either van Ermengem's, Pitfield's or Löwitz's methods. It magnifies the size of the cells and flagella in a manner that is especially favorable for class demonstration.

Egg Medium for the Cultivation of Tubercle Bacilli: M. Dorset, Biochemic Laboratory, Washington, D. C.

A further report of the results obtained by the use of this medium which had been previously described in *American Medicine,* April 5, 1902, and the 'Eighteenth Annual Report of the Bureau of Animal Industry,' 1901.

Cultures were made from more than seventy-five tuberculous rabbits and guinea-pigs, with almost uniform success, the few failures being traceable to a contamination of the culture tubes or the presence of very small numbers of tubercle bacilli in the tissues from which the cultures were taken. The medium seems to be specially well adapted for obtaining the first growth of tubercle bacilli from animals. Tubercle bacilli of bovine origin gave a slightly less abundant growth than the human tubercle bacilli, and the gross appearances of the cultures differed slightly. The morpho-

logical characters of human and bovine tubercle bacilli when grown on egg have been left for future report.

Studies on Quantitative Variations in Gas Production in the Fermentation Tube: C.-E. A. WINSLOW, Massachusetts Institute of Technology, Boston, Mass.

Experiments were made to determine the amount of variation in gas formation in a series of dextrose broth tubes filled with the same batch of culture medium and inoculated with the same organism. For inoculation, measured portions of an aqueous suspension of the surface agar growth of a strain of *B. coli* were used. A wide variation between individual tubes was observed. Thus in one case with tubes receiving the same amount of culture material the amount of gas varied from 20 per cent. to 62 per cent. of the closed arm after 16 hours, and from 38 per cent. to 86 per cent. after 64 hours. This was not simply a variation in the rapidity of the evolution of gas; for in this instance the maximum of gas formed in a given tube at any time varied from 42 per cent. to 86 per cent. By averaging the results obtained in a number of tubes more general relations became apparent. During the first 12 hours the amount of gas formed depended upon the amount of material used for inoculation, and the relative proportion of hydrogen was greater than at a later period. Between 24 and 48 hours the maximum of gas was generally formed with the classical gas formula of two to one, and after 48 hours a marked decrease of total gas occurred, due to the absorption of carbon dioxide. The principal point brought out was the wide variation in individual tubes due to some unknown factor, and apparently only to be avoided by making a series of duplicate analyses.

Preliminary Note on Chromogenic Cultures of B. diphtheriæ: HIBBERT WINSLOW HILL, Boston Board of Health Laboratory.

Six stock cultures of *B. diphtheriæ*, the originals of which had been isolated between March, 1901, and January, 1902, and since kept on serum, with reinoculation at intervals of one to two months, showed gradually increasing yellow color when streaked on serum.

Recently (December, 1902) this coloration became so striking as to attract definite attention. One of the six cultures (4014) isolated October 18, 1901, from a clinical case of diphtheria, and then typical morphologically and typically virulent to guinea-pigs, was selected for examination. The morphology and virulence, retested in December, 1902, were still typical.

Cultures from this stock developed the color on serum at 37° C., slightly in one day; by the third day the color was very marked—a clear bright yellow. The growth, removed by scraping, is treated with chloroform, which dissolves the pigment. After filtration to remove the bacilli, evaporation to dryness deposits the pigment, which is then found soluble in chloroform and in ether, but not in water. The same culture grown on agar for the same time yields only an ordinary dirty-white tint. When treated similarly, such dirty-white cultures yield a small amount of faint grayish-brown pigment. From fresh uninoculated serum of the same lot ether extracts a yellow pigment, but chloroform does not.

The writer has observed cultures of *B. diphtheriæ* showing a faint pink color, and others which, especially when old, show quite dark-brown or black coloration.

The Chemistry of Bacterial Pigments: M. X. SULLIVAN, Brown University.

While growing bacteria upon synthetic

media, I noticed that often chromogenic varieties became colorless. Accordingly experimenting to determine what salts, bases or acids in addition to the organogens, carbon, hydrogen, oxygen and nitrogen, are necessary for pigment production, I found, with Jordan, that for the formation of fluorescent pigment, sulphates and phosphates are required. Extending the research to other pigments, such as those produced by *B. pyocyaneus, B. prodigiosus, B. ruber balticus, B. rosaceus metalloides, B. janthinus* and *B. violaceus,* I found that the characteristic pigments were produced whenever there were present, in addition to suitable compounds of carbon, hydrogen, oxygen and nitrogen, phosphates together with sulphates, chlorides or nitrates, irrespective of the base. Suitable compounds of C, H, O, N, are asparagin, and the ammonium salts of succinic, lactic and citric acids. The solutions containing asparagin were the best, so that upon a medium consisting of asparagin 0.2 per cent., $MgSO_4$ 0.02 per cent., K_2HPO_4 0.1 per cent., glycerin 2 per cent., the pigments were quickly produced. Magnesium and potassium may be replaced by other bases, as sodium or ammonium. If the glycerin is left out the asparagin must be increased to 1 per cent. to get good pigment formation. Upon media consisting of $(NH_4)_3PO_4$ 0.1 per cent., $(HN_4)_2SO_4$ 0.1 per cent. and glycerin 2 per cent., there occurred a good production of pigment.

Replacing the asparagin and glycerin by ammonium salts of organic acids, 0.2 per cent. to 0.5 per cent., I found that while the succinate, lactate and citrate gave pigment, the tartrate, oxalate, urate and formate, though allowing growth, were unfavorable to chromogenesis.

By testing the chlorides and nitrates as to pigment formation, it was found that upon a solution consisting of asparagin 1 per cent., K_2HPO_4 0.02 per cent., NaCl or KCl 0.2 to 0.5 per cent., or KNO_3 0.02 per cent. the pigment was formed, though less abundantly than when $MgSO_4$ was present. On the other hand the sulphides, bromides and iodides were unfavorable to pigment production.

The conclusions to be drawn are that, in addition to suitable compounds of C, H, O, N, phosphates and sulphates are necessary for the fluorescent pigment, while for the pigments of *B. pyocyaneus, B. prodigiosus, B. rosaceus metalloides, B. ruber balticus, B. janthinus* and *B. violaceus,* the sulphates may be replaced by the chlorides or nitrates.

The Pyocyanin and Fluorescent Functions of Bacteria: M. X. SULLIVAN, Brown University.

Since Gessard's discovery in 1882 of a bacillus which produced a blue or blue-green pigment soluble in chloroform, many experiments have been carried on not only as regards the morphological characters of the bacillus to which Gessard gave the name of *B. pyocyaneus,* but also as to the nature of its pigments. In the study of *B. pyocyaneus,* many varieties have been isolated, so that at present we have kinds which produce pyocyanin alone, others which produce both pyocyanin and a greenish-yellow fluorescent pigment, insoluble in chloroform, but soluble in alcohol and ether, and further, some perhaps degenerate types, which produce a fluorescent pigment only. Now the question is, what is the relation between the different varieties of this bacillus? Are the varieties characterized by the ability to produce a different pigment or pigments, or can the same race be compelled to form different colored products according to the medium on which it is grown? That the latter view is the correct one would seem to be

the conclusion from the following experiments.

A variety which produces pyocyanin only on a medium consisting of asparagin 1 per cent., $MgSO_4$ 0.02 per cent., K_2HPO_4 0.1 per cent., can be made, by gradually increasing the phosphate to 0.5 per cent., to produce both pyocyanin and fluorescent pigment. In this case there is very little pyocyanin and a great deal of the fluorescent pigment. Another variety, which was producing both pyocyanin and the fluorescent pigment, was made to produce the fluorescent pigment alone on asparagin 0.2 per cent., $MgSO_4$ 0.02 per cent., K_2HPO_4 0.5 per cent. This same variety upon asparagin 1 per cent., $MgSO_4$ 0.05 per cent., K_2HPO_4 0.2 per cent., strongly acid, produced pyocyanin alone.

Turning now to the common *B. fluorescens liquefaciens,* which on asparagin 1 per cent., $MgSO_4$ 0.02 per cent., K_2HPO 0.1 per cent., produced the fluorescent pigment. I gradually lessened the phosphate and in another series the sulphate to determine whether or not this bacillus could be induced to take up the pyocyanin function. The fluorescent pigment disappeared and the growth became colorless, but no pyocyanin was produced.

The conclusions to be drawn are that the same variety of *B. pyocyaneus* can be made to produce pyocyanin alone, pyocyanin and a fluorescent pigment, or the fluorescent pigment alone, according to the medium upon which the bacillus is grown; but that the purely fluorescent bacilli can not be made to take up the pyocyanin function.

A Preliminary Chemical Study of Various Tubercle Bacilli: E. A. de Schweinitz and M. Dorset, Biochemic Laboratory, Washington, D. C.

Dr. de Schweinitz gave, for himself and Dr. Dorset, a brief résumé of the work carried on by the Biochemic Laboratory of the Department of Agriculture so far, upon a chemical examination of the following bacilli: bovine, horse, swine, avian, virulent human and attenuated human. He pointed out that the conclusions which might be drawn from these analyses indicate a closer resemblance in the composition of the germs between the moderately virulent human bacilli and the bovine and swine, than between the moderately virulent human and the very attenuated human bacilli. The analyses also indicate a closer relationship in composition between the attenuated human bacilli and the avian bacilli, than between the two varieties of human bacilli used. He also called attention to the fact that a similar comparative examination of human bacilli and bovine bacilli of various degrees of virulence was being carried out. Attention was called, further, to the fact that the large amount of phosphoric acid obtained from the germs indicated that this constituent was absolutely necessary for the proper development of these bacilli, and it was noted that for a number of years in all the work in the study of tubercle bacilli in the Biochemic Laboratory, culture media had been prepared with the addition of acid potassium phosphate, and that sodium chloride had been entirely eliminated. The results had been uniformly more satisfactory than with any liquid medium that has been used for the tuberculosis bacilli. The importance of a chemical study, not only of the tubercle bacilli themselves, but also of their products, was emphasized.

The authors further presented the history of a case of generalized tuberculosis in a child of five years of age that had been brought up on milk. The cultures obtained from the mesenteric glands of this child had produced generalized tuberculosis in a heifer, after subcutaneous inoculation, within about a month. Drawings which showed the appearance of the lung

from this calf, and also the appearance of the liver of a pig, which had also been submitted to subcutaneous inoculation with this germ, were shown. In addition, drawings showing the comparative results of a subcutaneous inoculation of bovine and human tubercle bacilli in monkeys were presented. These indicated that the bovine tubercle bacilli were very much more virulent for the monkey than the human tuberculosis bacilli used. In the discussion which followed this paper, Dr. de Schweinitz further stated that the cultural characteristics of the germ which had produced the tuberculosis in the heifer upon subcutaneous inoculation appeared to be those which some authors claim to be possessed only by the bacilli derived from the bovine species, and that further, whether the germ that killed the heifer was regarded as a bovine germ or a human germ, the conclusions naturally were of equal value; for if the germ was of bovine origin, then it seemed that tuberculosis in children could be produced by bovine bacilli. If, on the contrary, the germ was what is commonly called the human germ, then it was a germ which was virulent for cattle. He also called attention to the fact that the attenuated human germs used in the chemical study referred to were the offspring of the same attenuated germs which had been used a number of years ago for the purpose of producing immunity to tuberculosis in small animals, by subcutaneous inoculation. These results were published at the time, in the *Medical News*, December, 1894.

Reference was also made to the fact that tuberculin prepared from bovine bacilli, and tuberculin prepared from the virulent or attenuated human bacilli, when tested interchangeably on men and animals, seemed to give the same positive results. A résumé of these tuberculin tests was published in *American Medicine*, in January, 1902.

Further Evidence of the Apparent Identity of B. coli and Certain Lactic Acid Bacteria: S. C. Prescott, Massachusetts Institute of Technology, Boston, Mass.

Last year it was reported by the author that certain lactic acid bacteria isolated from grains and products of milling gave all the cultural reactions generally regarded as typical of *B. coli*. In the present work cultures of 'lactic acid bacteria' were isolated from various sources apparently free from contamination with fæcal matter, and were compared directly with 23 cultures of *B. coli* obtained either directly from fæces or from waters known to be sewage-polluted. Of these 61 cultures, 44 gave exactly the same reactions in the culture tubes, 25 of them being lactic acid bacteria, and 19 typical colon bacilli. These organisms were also found to be alike in their morphological characters.

A study of the fermentative power showed that the 'lactic acid bacteria' and 'colon bacilli' produced approximately the same amount of acid when grown under similar conditions, while organisms of different groups, as for example streptococci, gave results showing a marked difference in fermenting power.

As a final test the effect of inoculation into animals was noted, with the result that lactic acid bacteria and colon bacilli produced the same results when used in the same manner and with like amounts. Subcutaneous injection of 1 c.c. produced dullness and torpor, followed by rise of temperature, while intraperitoneal inoculation of 1.5 c.c. produced death within twenty-four hours.

As a result of the experiments the author believes that the organisms studied are not merely alike in certain characteristics, but are absolutely identical, and thus that or-

ganisms having the same characteristics as *B. coli* are very widely distributed in nature, and their presence, unless in considerable numbers, is not necessarily indicative of recent fæcal contamination.

On the Relative Viability of B. coli and B. typhosus under Certain Conditions: Stephen DeM. Gage, Lawrence Experiment Station.

In various studies of both *B. coli* and *B. typhosus* at the Lawrence Experiment Station, a number of points of similarity in the behavior of the two species under certain conditions have been noted, which appear to have a bearing on the interpretation of tests for *B. coli*.

1. As regards sand filtration. With a water to which both species have been added, 99.9 per cent. of all the *B. coli* and 100 per cent. of the *B. typhosus* were removed by an intermittent filter, and 99.8 per cent. of *B. coli* and 99.9 per cent. of *B. typhosus* by a continuous filter.

2. As regards the persistence of the two organisms in a filter after infection of the applied water has ceased, *B. coli* was found to continue in the effluent from the intermittent filter for 24 to 36 hours, and *B. typhosus* only for two to three hours.

With the continuous filter *B. coli* continued for four to six days and *B. typhosus* for two days.

3. Effect of cold without freezing. In a water subjected to a temperature of 33° F., about 90 to 95 per cent. of both species were destroyed in 24 hours; a few organisms of each, however, may live for a considerable number of days.

4. Elimination by freezing and viability in ice. About 50 per cent. of the *B. coli* and 75 per cent. of the *B. typhosus* were destroyed by fifteen minutes' freezing; after one hour, 95 per cent. of the *B. coli* and 98 per cent. of *B. typhosus* were killed; and at the end of 24 hours over 99 per cent. of all the organisms had disappeared. Of the few organisms surviving, however, *B. coli* were found alive after three months, and *B. typhosus* after nine months, in the frozen condition, these experiments being still in progress at the present writing.

5. Resistance to heat. Both species resist temperatures up to 45° C. for five minutes. At between 45° and 55° C. all but a few individuals of each are destroyed, these few individuals, however, resisting temperatures up to 85° C. at which temperature all the organisms of both species were destroyed.

The effect of sunlight and the relative viability of both species in both sterile and natural waters are being studied, and from the data at hand a similarity between the two species will also appear.

The Germicidal Properties of Glycerine in Relation to Vaccine Virus: M. J. Rosenau, Hygienic Laboratory, Washington, D. C.

The bacteriological examination of many dry points and capillary tubes of glycerinated virus bought upon the open market showed an excessive contamination, due to an over-confidence in the germicidal properties of glycerine. About one year ago, of 41 dry points examined, there was found an average of 4,807 organisms per point; of 51 glycerinated tubes examined, there was an average of 2,865 colonies per tube, some individual tubes running as high as 18,000. Following a publication of these facts and the warning given to manufacturers that glycerine is not a substitute for care, a great improvement in the bacteriological contents of glycerinated virus on the market resulted. Thus, of 89 tubes examined an average of only 28 organisms per capillary tube was found as a result of recent studies.

Glycerine has distinct antiseptic powers. It restrains the growth of most bacteria in dilutions of 35 per cent.; molds grow on the surface of bouillon containing 48 per cent.; no growth was observed above 50 per cent. Its germicidal properties are very feeble. It has practically no effect on spores, anthrax and tetanus being the spores tested. Tetanus, however, does not multiply in glycerinated lymph, nor in bouillon containing 60 per cent. of glycerine, the amount used by manufacturers in glycerinated virus.

It was found that the antiseptic and germicidal powers of glycerine varied somewhat with the kind of glycerine used, and also with the organisms tested. Cholera and plague were retarded by the presence of 21 per cent. to 24 per cent., while pus cocci grew in 31 per cent. and some molds grew on the surface in 48 per cent. Pus cocci are usually rendered sterile in 50 per cent. glycerine within five days, though they were kept alive as long as ten days in the ice-chest; they died more quickly at incubator temperature. In 80 per cent. and 90 per cent. glycerine Staphylococcus pyogenes aureus was kept alive in the ice-chest at 12° C., 41 days. Anthrax spores have been kept alive 247 days and the experiments are still going on. Tetanus spores were found viable in various percentages of glycerine after 135 days in the ice-chest.

The Reaction of Certain Water Bacteria with Dysentery-Immune Serum: D. H. Bergey, University of Pennsylvania, Philadelphia.

A Mold Pathogenic to Lobsters: F. P. Gorham, Brown University.

Complete Inhibition of the Cholera-Red Reaction by Impure Peptone. James Carroll, Army Medical Museum.

Demonstration of the Value of MacConkey's Medium for the Differentiation of B. coli from B. typhosus: N. MacL. Harris, Johns Hopkins University.

Edwin O. Jordan,
Secretary.

SCIENTIFIC BOOKS.

Ueber verschiedene Wege phylogenetischer Entwickelung. By O. Jaekel. Jena, Gustav Fischer. 1902. 8vo. Pp. 60; 28 text-figures.

Der Neo-Lamarckismus und seine Beziehungen zum Darwinismus. By R. von Wettstein. Jena, Gustav Fischer. 1903. 8vo. Pp. 30.

The intensity which a few years ago characterized the struggle between the opposing camps of Neo-Lamarckism and Neo-Darwinism has, fortunately, largely subsided. Some new standpoints have arisen, notably those afforded by the doctrine of organic selection and by the rediscovery of the Mendelian law, and there has been a general tendency to inquire more thoroughly into the laws of variation and to seek for the factors concerned in that phenomenon.

The first of the two pamphlets which form the subject of this notice represents a phase of this tendency, and is of interest as exhibiting the views of a paleontologist who has had access to and has made admirable use of an exceptional abundance of material bearing upon the questions he discusses. In his opening pages Professor Jaekel combats the idea that if the paleontological record were complete it would furnish evidence of almost insensible transition from species to species, so that no 'good' species could exist for the paleontologist, and points out that an exhaustive search for confirmation of this idea, extending through the last three decades, has brought to light only three more or less acceptable cases, namely, those of the Steinheim *Planorbis* and of the Pannonian and Kossian *Paludinas,* none of which shows any more gradation than may be found in variable species of recent land snails.

The conclusion is reached, accordingly, that the distinctness of species was just as pronounced in the past as it is to-day, and that the idea of species has a definite morphological value. But this distinctness can not have been brought about by successive and promiscuous minglings of the germ plasm, by amphimixis; the rôle of this has rather been to annul in the course of generations extreme variations, and, granting the limitation of amphimixis to a group of forms by the action of migration, isolation or some other such factor, the result will have been the consolidation or concentration of certain characters, determined by the environment, and the formation of a species. A species, then, is 'a product of individual variation and limitation of crossing, and represents a local departure from the general tendency of development'; it is a fixation of one of the rapidly changing pictures produced during a general developmental progress.

What then are the factors which determine the general developmental tendency? Of these Professor Jaekel discusses three, namely, orthogenesis, epistasis and metagenesis, none of which is entirely unfamiliar, although the last two may not be recognizable under their new names. The factor of orthogenesis is essentially the orthogenesis of Eimer and the 'Vervollkommnungstrieb' of Nägeli, extended, however, so as to include progressive modifications of parts as well as of the entire organism, and to embrace as well retrogressive as progressive modification. As examples of its action there are cited the progressive modifications in the structure of the arms in the Melocrinidæ and Taxocrinidæ, the gradual migration of the anus in the Caryocrinidæ from the lower region of the theca to its upper margin, and the progressive complication of the septal lines in the Ammonitidæ.

Epistasis is a modified form of the process emphasized by Boas under the name of neotenia, a reversion of a phylum to a modified embryonic condition. Evidence for such a factor is found again among the crinoids, in the apparently reversionary peculiarities observable in certain groups, and also in the Saleniidæ and in the Agnostidæ among the trilobites, whose small number of free body segments is regarded as due to an inhibition of development, rather than as an ancestral character. So too the transition of the Acanthodidæ of the Devonian period, with numerous dermal bones on the head and shoulder girdle and with acrodont teeth, to their Permian descendents which some paleontologists have regarded as true selachians, is advanced as a case much to the point, and the discovery of two Paleozoic cyclostomes which show, when compared with the more ancient *Palæospondylus*, a marked diminution of osseous material in the skeleton, leads to the supposition that this group of fishes may also have arisen as the result of epistasis. It must be confessed, however, that the morphologist who may have followed Professor Jaekel up to this point with interest, if not with absolute confidence, will draw a deep breath when he reads that the author is inclined to regard the entire group of the fishes as degenerated vertebrates, whose watery environment inhibited their normal development 'und die Formen namentlich in ihrer Atmung zur Stadien zurückführte, wie wir sie bei Crustaceen antreffen.'

Finally, under the factor of metakinesis there are found the results of what embryologists term cenogenetic modification, for the process is defined as a profound modification of a form in a manner impossible in the adult and only possible in a young stage in which the various organs are not yet histologically specialized and still possess more or less plasticity. Examples of the action of this force are again drawn from the crinoids, but these can not, within due limits, be detailed here. Among the echinoids the development of the irregular forms from the regular is regarded as the result of metakinesis, and the occurrence in the Trias of *Tiarechinus*, with more than two rows of interradial plates, is quoted among other examples of its action.

Such, in brief, are the ideas which Professor Jaekel advances in his pamphlet, which, it may be said, is a reprint from the 'Verhandlungen des V. Internationalen Zoologen-Congresses.' The ideas are not entirely novel, nor does their exposition free the mind of a

sense of something yet lacking for the complete solution of the question. It is not clear why epistasis and metakinesis may not well be regarded as particular cases of orthogenesis as Professor Jaekel defines that factor, and, if amphimixis have no place or part in the production of the orthogenetic progress, what is its source and maintenance? The paper, however, is full of interest, the ideas being clearly and forcibly expressed, and accompanied by a wealth of illustration drawn from sources unfamiliar to the majority of biologists.

The second paper, that of Professor von Wettstein, is a relapse into the old discussion, since it takes as its thesis the combined action of the Darwinian and Lamarckian factors in the origin of species. It can not be said, however, that the evidence adduced by the author from the botanical field in favor of Lamarckianism is more apt to carry conviction to the minds of Selectionists than much that has already been presented. The fact, for instance, that an asporogenous variety of yeast, produced by exposure to an abnormally high temperature, does not again become sporogenous when grown at a normal temperature, will not be regarded by Selectionists as proof of the Lamarckian position, since they recognize the inheritance of acquired characters, if so they may be called, in unicellular organisms. Nor will the gradual assumption of the peculiarities of Hungarian wheats by foreign varieties grown in that country prove to them a stumbling-block, since such changes may plausibly be explained as the results of the direct action of the environment upon the germ plasm and through it upon the somatic cells. The author, in fact, fails to take into account the fundamental idea of the Selectionist standpoint, namely, the isolation of the germ plasm, and, like many of his predecessors, assigns to the term 'acquired characters' a meaning very different from that which it possesses for a Selectionist.

J. P. McM.

Municipal Engineering and Sanitation. By M. N. Baker. New York, The Macmillan Company. 1902. 12mo. Pp. 317. $1.25. In the Citizen's Library.

The phenomenal growth of cities which has been so characteristic a feature of the last two decades has brought us face to face with many new and important problems. It sometimes seems as if these problems were increasing faster than the abilities of our cities to solve them; but to students of sociology it is an encouraging sign of the times to note the interest which is being rapidly awakened in municipal affairs among local organizations such as boards of trade, village improvement societies, women's clubs, as well as among individuals. It leads one to hope that in the not distant future the '*age of the politician*' may be succeeded by the *age of the good citizen.* To all who are interested in municipal affairs, especially in those matters which relate to the control of the forces of nature, Mr. Baker's book on 'Municipal Engineering and Sanitation' can be heartily recommended. It is a review of the whole field, and touches the vital points of many classes of activity. It describes the underlying principles of all, but does not pretend to give detailed information about any one. The subjects treated are grouped under five heads, as follows: 'Ways and Means of Communication'; 'Municipal Supplies'; 'Collection and Disposal of Wastes'; 'Protection of Life, Health and Property'; 'Administration, Finance and Public Policy.' The forty-three chapters of the book relate to streets and pavements, bridges, ferries, docks, telephones; water, ice, milk, markets, lighting and heating; sewerage, street-cleaning, garbage disposal, cemeteries; fire protection, smoke abatement, public baths, dwellings, parks; city charters, contracts, franchises, municipal ownership, taxation, uniform statistics, etc. These subjects are treated concisely, and a hasty reading of the book might lead one to think that they were treated too concisely, that the book was, in fact, a mere explanatory catalogue of unsolved municipal problems. This opinion would be far from the truth. Embellishments of rhetoric and extended illustrations are not to be found, but all the essential facts are there and where no facts are obtainable no attempt is made to conceal it by indulging in generalities. The book

is to be commended almost as much for what it omits as for what it includes. It shows evidence of accurate knowledge and careful preparation, as might be expected from the pen of the associate editor of the *Engineering News*. Several chapters were written by the author's wife, Mrs. Ella Babbitt Baker, and these are among the most interesting in the book. The book gives comparatively few references, a fault for which the author atones by referring to Robert C. Brook's 'Bibliography of Municipal Problems and City Conditions' (New York, 1901).

A comparison of the title of the book with its table of contents shows to what wide limits the scope of the 'engineer' has extended. 'Municipal housekeeping' is a term which has been applied not inappropriately to certain groups of activities, but 'municipal engineering' is much nearer the truth. Whenever forces are to be controlled and materials handled on a large scale, there the engineer is to the fore. So in our growing cities activities that once were domestic or individual have become engineering in their nature and must be entrusted to technical men. The author well says: 'Happily the day is coming when permanent and well-paid technical men will be put in charge of all technical work, and the most experienced specialists of the country will be called in to aid in the construction and testing of all public works and to advise from time to time regarding the best mode of operation.'

American Municipal Progress—Chapters in Municipal Sociology. By CHARLES ZUEBLIN. New York, The Macmillan Company. 1902. 12mo. Pp. 380. $1.25. In the Citizen's Library.

The author begins his introductory chapter in the good old German way by defining his terms. He draws a distinction between the 'urban district,' 'city' and 'municipality'; the first having 'a psychological and industrial unity,' the second, 'a legal and topographical unity,' and the third 'a functional unity.' He considers the municipality as the organization for supplying communal needs, and defines 'municipal sociology' as the science which 'investigates the means of satisfying communal wants through public activity.' Illustrations of these definitions then follow.

The work is divided into chapters which treat respectively of 'Municipal Sociology'; 'Transportation'; 'Public Works'; 'Sanitation'; 'Schools'; 'Libraries'; 'Public Buildings'; 'Parks'; 'Public Recreation'; 'Public Control, Ownership and Operation.' It is written in a discursive style, and the principles set forth are sometimes obscured by an overabundance of illustration. It is in these illustrations, however, that the work is chiefly valuable. The author, who is professor of sociology in the University of Chicago, evidently has at hand an extensive collection of data from the chief cities of America upon all phases of municipal work, and the comparisons which he makes between the different cities are most instructive. It is interesting to observe the different directions in which engineering effort has been bent in different cities. One city, for example, excels in its parks, another in its streets, another in its schools, another in its water supply, etc. The book gives the impression of being written by one who has studied the work of others rather than by one who has taken part in it himself. It is somewhat inclined to be theoretical rather than practical. For instance, the author still clings to the idea that the cost of sewage disposal may be met by separating the solid matter 'through familiar processes' and selling it as a fertilizing material, while sanitary engineers agree that this is, at present at least, impractical. The last chapter, on 'Political Control, Ownership and Operation,' is perhaps the most valuable one in the book. It shows the modern tendency towards public absorption of municipal functions, an evolution towards socialism which the author manifestly approves. The work concludes with numerous appendices giving interesting statistics for various American cities, and digests of laws affecting schools, child labor, etc. G. C. WHIPPLE.

A Text-book of Quantitative Chemical Analysis. By FRANK JULIAN. St. Paul, Minn., The Ramsey Publishing Company. 1902. 8vo. Pp. 604. Illustrated. $6.00.

This voluminous work is from the brain and pen, not of a teacher, but of the chief chemist in the Great Northern Railway Shops, St. Paul, and naturally reflects the practical experience of its industrious author. To attempt to review in a conscientious manner a closely printed volume of more than six hundred pages, estimated to contain over four hundred thousand words, is impossible in the time and space that can be given. The author states that the 'volume is intended for the aid of students who have a fair acquaintance with the elements of general chemistry and can devote a limited time to quantitative analysis concurrent with or following the usual qualitative course.' At the same time it will form 'an introduction to the monographs on special departments of technical analysis for those purposing to engage in some particular branch as a future occupation.'

After outlining the general principles of the subject and describing the operations usually employed, the book presents a graded series of exercises for practice; these comprise twenty-four examples of great diversity, alcohol, ferrous sulfate, coffee, cast iron, ether, vinegar, hydrastis, metol, steel, barium chloride, lard, air and wollastonite, with others, in the sequence here given.

Then Part III. begins, at page 259, and deals with the analytical behavior of articles of commercial importance; these embrace, among others, iron ores, coal, natural water, fertilizers, alkaloids, tannins, carbohydrates, soap, milk and butter, and urine, besides methods based on colorimetry, electrolysis, and organic analysis both proximate and ultimate.

Part IV., beginning at page 521, gives notes and observations relating to the art in general. The volume closes with an appendix on 'Technical and Industrial Analysis,' and an index.

This work is in some degree encyclopedic; the author shows familiarity with many branches of the subject, and the numerous citations show a wide knowledge of the literature, especially American. He has rescued from the pages of periodicals many good methods little used in laboratories, giving their authors due credit. He shows throughout ability, thoughtfulness and universality. The arrangement of some of the matter is open to criticism. The book adopts the modern spelling of 'sulfur'; it is freely illustrated; its rather small type was probably necessitated by its length; there are about seven hundred words on each page. The paper, type and binding are hardly up to the high standard adopted for other works of like character.

This comprehensive treatise of Mr. Julian contains many processes, as well as specific details of ordinary methods, not easily found elsewhere, and ought to be serviceable in the libraries of technical schools and universities as a work of reference. H. C. B.

SCIENTIFIC JOURNALS AND ARTICLES.

BIOLOGICAL BULLETIN.

VOLUME IV., No. 1, December, 1902:

1. G. T. Hargitt, 'Notes on the Regeneration of *Gonionema.*'

A résumé of experiments conducted at the Marine Biological Laboratory, Woods Holl, during the summer of 1901, and extending the previous work of C. W. Hargitt and Morgan.

2. C. W. Hargitt, 'Notes on a few Medusæ new to Woods Holl.'

This paper is part of the synopsis of the medusoid fauna of the region which it is hoped may be ready within the year.

3. Walter S. Sutton, 'On the Morphology of the Chromosome Group in *Brachystola magna.*'

The conclusion is that the association of paternal and maternal chromosomes in pairs and their subsequent separation during the reducing division may constitute the physical basis of the Mendelian law of heredity. This subject will be continued in a later number of the *Bulletin.*

4. Ida H. Hyde, 'The Nervous System in *Gonionema Murbachii.*'

A study of the distribution of the nervous system with reference to its physiology.

VOLUME IV., No. 2, January, 1903:

1. Harold Heath, 'The Habits of California Termites.'

2. J. H. Elliot, 'A Preliminary Note on the Occurrence of a *Filaria* in the Crow.'

Records the discovery of embryo filariæ in the blood and of *Halderidium* in the red corpuscles.

3. Mary J. Ross, 'The Origin and Development of the Gastric Glands of *Desmognathus*, *Amblystoma* and Pig.'

This work was submitted to the Faculty of Cornell University for the degree of Doctor of Philosophy.

4. H. F. Thatcher, 'A Preliminary Note on the Absorption of the Hydranths of Hydroid Polyps.'

The conclusion is reached that the process is not liquefaction of protoplasm, or of withdrawal of the polyp as a whole. The absorption takes place by the degenerating cells of the endoderm and ectoderm being turned into the digestive tract of the colony.

VOLUME IV., No. 3, February, 1903:

1. Axel Leonard Melander, 'Notes on the Structure and Development of *Embia texana*.'

2. W. R. Coe and B. W. Kunkel, 'A New Species of Nemertean (*Cerebratulus melanops*) from the Gulf of St. Lawrence.'

3. R. P. Cowles, 'Notes on the Rearing of the Larvæ of *Polygordius appendiculatus* and on the Occurrence of the Adult on the Atlantic Coast of America.'

The rearing of the larvæ of an American *Polygordius* by the diatom method, and its identification with the European species *appendiculatus*.

4. Arthur W. Greeley, 'On the Effect of Variation in the Temperature upon the Process of Artificial Parthenogenesis.'

The length of exposure to the solution necessary to produce artificial parthenogenesis of the unfertilized eggs of *Asterias* and *Arbacia* varies inversely with the temperature. An increase of temperature to 27° C. liquefies the protoplasm of the *Asterias* eggs and produces a fragmentation of the nucleus.

5. Wm. Morton Wheeler, '*Erebomyrma;* a new genus of Hypogæic Ants from Texas.'

Containing an account of the first ant-genus to be established by an American.

Science Abstracts will in future be published in two sections, *Section A:* physics embracing light, including photography; heat; sound; electricity and magnetism; chemical physical and electro-chemistry; general physics; meteorology and terrestrial physics; physical astronomy. *Section B:* embracing steam plant, gas and oil engines; automobiles; oil-engine-driven ships and launches; balloons and airships; general electrical engineering, including industrial electro-chemistry; electric generators, motors and transformers; electrical distribution, traction and lighting; telegraphy and telephony. The American Physical Society is now joined with the Institution of Electrical Engineers and the Physical Society of London in the direction of the publication and has elected Professor E. H. Hall of Harvard University as its representative on the publishing committee. In consequence of this arrangement, Section A will in future be received by all members of the American Physical Society. The American Institute of Electrical Engineers is also co-operating with the committee and taking special means to bring the publication to the notice of all its members, who will in future be able to obtain it at a reduced subscription rate through the secretary of the American Institute.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

AT the meeting of the section on January 5, the following papers were presented: Mr. C. C. Trowbridge on 'Some Facts Regarding Persistent Meteor Trails—the significance of size, color and drift'; Professor Harold Jacoby on a 'Comparison of Astronomic Photographic Measures With the Reseau and Without it.'

At the meeting of February 2, Mr. Herschel C. Parker read a paper on 'Experiments Concerning Very Brief Electrical Contacts,' exhibiting contact keys by means of which he could get a fairly accurate range of adjustment from 0.1 second to 0.00001 second.

Professor Marston T. Bogert gave a very interesting talk on 'Some Products Derived from Coal,' paying special reference to the products from coal-tar. From bituminous coal, by distillation, are derived: (1) Coal gas, (2) ammonia water, (3) tar and (4) coke.

The uses of coal-gas and coke are so well known as to need no mentioning. In the United States, the total production of ammonium compounds for the year 1900 amounted to 2,700 tons, valued at about $2,000,000.

The chief source of coal-tar is the coal-gas manufacture, but large amounts are also obtained from the by-product coke ovens, the water-gas industry, etc. During the year 1900, twenty per cent. of the gas produced in the United States was coal-gas, requiring the distillation of 1,350,000 tons of coal, and producing thirteen and one half billion cubic feet of gas, *i. e.*, 10,000 cubic feet per ton of coal. The yield of tar is approximately five per cent. of the weight of the coal used; the product of tar was, therefore, 67,000 tons. If we add to this the 52,000 tons of tar from the by-product coke ovens, we have a total of about 120,000 tons of tar produced in 1900 from coal. This is less than one fifth of the amount produced in England from similar sources. The total production of coal-tar in Europe for the year 1898 was 1,120,000 tons.

Coal tar is first roughly divided into the following fractions: (1) First runnings, or light oil (lighter than water); (2) middle oil, or carbolic oil; (3) heavy oil, dead oil, or creosote oil; (4) anthracene oil, or green grease; (5) pitch (remains in the stills).

These five products were taken up in detail, and about one hundred drugs, perfumes, etc., were exhibited, the method of derivation of the substances being explained.

S. A. Mitchell,
Secretary of Section.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 366th meeting was held Saturday, February 7.

Vernon Bailey spoke on 'The Goodnight Herd of Buffaloes and Cataloes in Texas,' saying that this comprised fifty buffaloes and about seventy cataloes, or crosses between the buffalo and domesticated cattle. The breed selected for crossing was the Polled Angus, and the half-bloods resembled these more than they did the buffalo, being black, of the same build, and often hornless. This cross has most excellent beef qualities, growing rapidly and reaching a weight of 1,800 pounds, while it is unusually hardy. Mr. Goodnight hopes to establish a fixed breed of this grade. So far all crosses have been between buffalo bulls and Polled Angus cows, the demand for buffaloes being such that the buffalo cows have been kept breeding pure-blooded calves.

T. H. Kearney presented a paper entitled 'Further Observations on the Effect of Sodium and Magnesium Salts, with and without Calcium, upon Seedlings.'

In experiments upon seedlings of the white lupine (*Lupinus albus*) it was found that the degree of toxicity of certain salts of sodium and magnesium was greatly affected by the presence or absence of calcium. In pure solution magnesium sulphate was found to be far the most toxic, and sodium bicarbonate the least. In solutions to which an excess of calcium sulphate had been added the order of toxicity was quite different, sodium carbonate being toxic in slightest concentration, while magnesium sulphate became decidedly the least toxic. In pure solution a 0.00125 normal solution of magnesium sulphate represents the maximum concentration permitting the root tips of lupine seedlings to retain their vitality during a twenty-four-hours culture. Upon the addition of an excess of calcium sulphate, however, the root tips could survive in a normal 0.6 solution of the magnesium salt.

The question whether other higher plants, under exactly similar conditions of experiment, would show a corresponding relation to the same salts, immediately presented itself. With lucerne or alfalfa (*Medicago sativa*) almost identical results were obtained, the salts proving toxic in the same order and almost in the same degree, both in pure solutions and in solutions to which calcium sulphate was added.

As it was desirable to ascertain the effects of these salts on plants of widely different relationships, the experiments were repeated on maize, the criterion of toxic effect being the death point of the strongest rootlet. Very unexpected results were obtained, for with pure solutions both the relative and the absolute toxicity of the salts were found to be widely different from those observed in the case of the lupine. In pure solution the salt which killed at the lowest concentration was sodium carbonate, while the least toxic of all was

magnesium sulphate. With the latter salt the root tip retained its vitality in a normal 0.25 solution, hence at a concentration of the pure solution two hundred times as great as the maximum which allowed lupine root tips to survive. Equally interesting results were obtained upon adding calcium sulphate to the solutions.

It is important, in view of the diverse results obtained, to continue the experiments with many different plants. Until that is done no generalizations are possible, and we may only say that the protoplasm of remotely related plants differs widely in its reaction to pure solutions of various mineral salts; while the addition of a calcium salt would appear to cause a certain amount of uniformity in the effect of each salt upon various organisms.

Frank Bond discussed 'Irrigation Methods and Machinery,' illustrating his remarks with lantern slides showing how the conditions varied in different states and the different types of dams, reservoirs, canals and devices for measuring the amount of water used. He concluded with some remarks on the great Assouam dam on the upper Nile.

F. A. Lucas.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 138th meeting of the society, held in the assembly hall of the Cosmos Club, Wednesday evening, February 11, 1903, the following program was presented.

Mr. W. C. Mendenhall, 'Chitina Copper Deposits, Alaska.'

The Chitina copper belt is in the eastern part of the Copper River basin, Alaska.

The deposits which have been exploited here are concentrations in various forms of copper, which is believed to have been distributed originally in minute quantities throughout an extensive series of basalt flows of pre-Permian age. The most promising ore bodies are found near the contact with a heavy limestone which overlies the basalts. They occur as veins in the limestone and in the greenstone or as 'bunches' in the greenstone only. The ores are usually bornite or chalcocite in the surface exposures. Chalcopyrite and native copper also occur.

Mr. David White, 'An Anthracite Coal Field Three and a half Hours West of Washington.'

Under this title the speaker contributed some observations on the Sleepy Creek mountain basin in Morgan County, West Virginia. It has recently been thought by some geologists that the coal-bearing series here might be of Pottsville age, but the stratigraphic and paleontologic evidence were stated by Mr. White to agree in indicating that the beds belong to the Pocono.

One very thick, though highly impure, coal has been exposed at a number of localities. Its anthracitic character is ascribed to the porosity of its rock environment and the alterative influences to which it has been subjected because of its extreme eastern position. This position perhaps accounts also for its exceptional thickness.

Mr. George W. Stose, 'The Structure of a Part of South Mountain, Pennsylvania.'

South Mountain, the Blue Ridge of southern Pennsylvania, is composed of Lower Cambrian quartzites and shales forming a flat-topped, steep-sided anticline exposing Algonkian volcanics in the center. The quartzites dip steeply beneath the limestone of the Cumberland valley and only small local faults, if any, occur along the western flank of the mountain.

Offsets of the mountain front are due to additional anticlines coming in on the northwest and plunging southwestward beneath the limestone, which partakes of the folding of the mountain rocks. The offset opposite Waynesboro is accentuated by faulting.

Mr. Geo. Otis Smith, 'Abandoned Stream Gaps in Northern Washington.'

The cases cited are in the Okanogan valley, and, as shown by photograph and contoured map, are peculiar topographic features, but very common in this region. Such series of gaps on the valley side result from the successive occupation by streams flowing along the side of an expanding valley glacier. Antoine Coulee, near the junction of the Methow and Columbia Rivers has been described by Professor Russell as the fissure behind a displaced block. Glacial and physiographic evidence

was cited, however, to show that this larger gorge was also the product of stream erosion at a time when the Columbia cañon was occupied by the Okanogan glacier with a thickness of ice exceeding 2,500 feet.

W. C. Mendenhall,
Secretary.

THE RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

The club met on the evening of January 21, and listened to a paper by Dr. C. L. Meader on 'The Acquired Meanings of the Latin Pronoun Idem,' and a paper by Professor H. S. Carhart on 'The Rôle of Thermoelectromotive Forces in a Voltaic Cell.'

The latter contained in brief the thermodynamic theory of a voltaic cell, so far as relates to its properties dependent on temperature. It was shown that all these could be completely explained by means of electrolytic thermoelectromotive forces between a metal and the liquid in contact with it. Thermoelectromotive forces exist without temperature difference at the junctions, for a current will either absorb or generate heat at a junction according to its direction in relation to that of the thermo-electromotive force there.

Data were given showing that the temperature coefficients of a Daniell cell, a Carhart-Clark cell, and a calomel cell are all accounted for numerically by the thermoelectromotive forces at the metal-liquid junctions.

It was also shown that the heat represented by the second term of the Gibbs-Helmholtz equation is the difference between the heat generated at the negative electrode, where the current flows against the thermoelectromotive force, and that absorbed at the positive, where both current and electromotive force are in the same direction. The effects are thus localized in the cell.

It was also demonstrated by curves and numerical data that the electromotive force of a concentration cell is explained for dilute solutions by the thermo-electromotive forces at the two electrodes, because this electromotive force increases with the density of the solution. For this last reason also thermoelectromotive forces explain the change in the electromotive force of a Daniell cell when the density of either solution is changed. All these conclusions have been confirmed by numerous measurements.

Frederick C. Newcombe,
Secretary.

ELISHA MITCHELL SCIENTIFIC SOCIETY.

The 146th meeting was held in the Chemical Lecture Room, University of North Carolina, February 10, at 7:30 p.m.

In a paper on 'The Biological Blood Test,' Dr. R. H. Whitehead gave an account of the recent work of Uhlenhuth in the serum-diagnosis of blood in various species of animals, and called attention to its great importance in certain medico-legal cases.

Under the title 'Recent Work on Corals,' Dr. J. E. Duerden gave an account of his work upon the septal development in recent and fossil corals. In recent corals the septa beyond the primary septa—metasepta—are found to appear bilaterally, in a dorso-ventral sequence, within each of the six primary systems, the adult radial symmetry being secondary. In certain Palæozoic corals the metasepta arise in a regular dorso-ventral succession within only four of the six primary systems.

'The Peter Cooper Hewitt Static Transformer' was described by Professor J. W. Gore.

Chas. Baskerville,
Secretary.

COLORADO ACADEMY OF SCIENCE.

The 31st, 32d and 33d meetings of the Colorado Academy of Science were held in the rooms of the State Historical and Natural History Society of Colorado, in the Capitol building, Denver, Colorado, October 21, November 18 and December 16, 1902. The membership of the academy is restricted to those members of the State Historical and Natural History Society of Colorado engaged in scientific work and investigation. These sessions of the academy have had an attendance ranging from about 100 to 300, and the outlook for the winter meetings is most encouraging.

At the 31st meeting the death of Professor A. M. Collett was announced, and Mrs. Cornelia S. Miles, first vice-president, became acting president. Mrs. Miles is principal of the Broadway School, Denver, Colorado, and has received the degree of A.M. in the graduate school of the University of Denver, and last summer was engaged in scientific work in the graduate school of the University of Chicago.

Professor George L. Cannon, who for a number of years had been engaged with Professor Collett in scientific work in the East Denver High School, gave a sketch of his life, and offered resolutions which were adopted.

Mr. E. B. Sterling delivered a lecture on 'puff balls,' obtained in Denver and vicinity, explaining the difference between them and the eastern forms. He pronounced the several species at Denver, so far as tested by his observations and experience, to be edible. His lecture was supplemented by a short address by Professor Ellsworth Bethel, a recognized authority on botany in Colorado. Professor George L. Cannon followed with an address on the 'Death of the Leaves,' contrasting the fall colors of this region with those of the East.

At the 32d meeting, 'Navajo Blankets, their History and Symbolism,' was the topic for discussion. After some introductory remarks by Dr. J. B. Kinley, Colonel U. S. Hollister spoke at length on the subject, illustrating his remarks by about sixty-five blankets from his own private collection. He described their system of weaving, use of dyes, and the meaning of the symbols.

Dr. A. L. Bennett delivered a lecture at the 33d meeting on the 'Value of the Cranial Capacity as Indicating the Degree of Intelligence Enjoyed by the Prehistoric Cliff Dwellers of our Great Southwest.' Dr. Bennett, in addition to being chairman of the Section of Anthropology and Ethnology of the Colorado Academy of Science, is also a fellow of the Anthropological Institute of Great Britain and Ireland. Dr. Bennett has spent considerable time examining and measuring the cranial capacity of the large collection of the Cliff Dweller skulls from the Mancos region, Colorado, in the museum of the State Historical and Natural History Society of Colorado. From data obtained in these measurements he gives them a higher grade of intelligence than has been accorded by some to these primitive people.

Mrs. W. S. Peabody read a paper on the 'Work and Plans of the Cliff Dwellings Association,' being an interesting review of efforts made to preserve from vandalism and the relic hunter the prehistoric ruins of the Southwest.

WILL. C. FERRIL,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE PUBLICATION OF REJECTED NAMES.

I WISH to speak quite respectfully of Mr. T. D. A. Cockerell; but surely systematists would be much happier if he and his like did not raise such disturbing questions as that in SCIENCE for January 30, p. 189. Had he chosen to condemn Messrs. Banks and Knowlton, first for wasting time, ink and paper over names that they never intended to use, secondly for presumption in substituting their own inventions for those of Marx and Lesquereux, then one would have applauded him. But all he objects to in them is that they inadvertently happened to print the so-called MS. names a page or so ahead of the new names proposed by themselves. Mr. Cockerell does not attempt to prove that the MS. names were published five minutes earlier, and it is clear that the publication of the old and new names was simultaneous in each paper. The precise number of pages, lines, or words that intervened can make no difference. Suppose that Mr. Banks had written as follows: "For this species of *Filistrata* there is a choice of two names: *F. oceanea* and *F. fasciata*. The name *F. oceanea* has been found on an unpublished label, but since in my opinion it is inappropriate, I shall call the species *F. fasciata*." Now to be consistent, Mr. Cockerell would have to insist that in writing thus Mr. Banks contravened the rules of nomenclature, because he introduced *oceanea* first. 'An two men ride of a horse, one must ride behind.' Surely an author does not lose his freedom of choice before he

has finished posing the question? On the contrary, I regard the names *F. oceanea* and *F. fasciata* as equal in their pretensions, until the choice is made. Once made, the person that attempts to upset it is the true begetter of confusion.

But does Mr. Cockerell's conclusion follow from his premises? The conception underlying his application of the law of priority is that place is to be reckoned as time. Now a specific name has no standing until a description of the species denoted thereby has been published, and until the name in question has been associated therewith. Till then it is a *nomen nudum.* The name *Filistrata oceanea* is, we are told, a *nomen nudum.* Even had it been published in a previous paper, it would, in the absence of a description, have remained a *nomen nudum.* It appears first on page 50 of Mr. Banks' paper, but without description; and it remains without description for five whole pages. During all this space, it remains a *nomen nudum.* Mr. Banks may asseverate as often as he pleases that *F. oceanea* is identical with *F. fasciata.* But *F. fasciata* does not exist (for Mr. Cockerell), except as a *nomen nudum,* till page 55 is reached. Here is a description at last; but the name associated with that description is not *F. oceanea* but *F. fasciata.* It is this latter then that ceases first to be a *nomen nudum.*

The case of *Cucumites lesquereuxii* Knowlton is different; but even this may, on Mr. Cockerell's principles, be defended. For it follows from the axiom 'place = time' that every name is a *nomen nudum* until the diagnosis or description is complete. But the description of the fruit under discussion once finished, Mr. Knowlton calls it, not *Cucumites globulosus*, but *C. lesquereuxii.*

Mr. Cockerell may retort that this is mere hair-splitting and childish chop-logic. It is. But it is the natural outcome of an attempt to subject mere modes of expression to a rule obviously intended to apply to essential matters and not to the niceties of style.

To save all misunderstanding, let me repeat emphatically that I am not defending either Mr. Banks or Mr. Knowlton. I have no sympathy with people who print names for the mere sake of rejecting them, or who tell us what they might have done or what somebody else might do if circumstances had been different, and so forth. If such action be in any degree checked by Mr. Cockerell's arguments, their publication will have had one good result.

F. A. Bather.

MOTION OF TRANSLATION OF A GAS IN A VACUUM. (REPLY TO MR. R. W. WOOD.)

In the hope that if I bring around Mr. R. W. Wood to my view of the energy required to set a gas in motion of translation in a vacuum, he will not find my explanation of the energy changes which take place when a gas expands into a vacuum unnecessary, I will only take up here that view.

Mr. Wood in his second note (Science for December 5) on a communication of mine to the American Association says:

> We sometimes find the statement in text-books that a gas expanding under such conditions that no work is done experiences no cooling, for example, when expanding into an infinite vacuum. It appears questionable, however, whether a gas can expand without doing work. Leaving out of consideration the internal work, *i. e.*, the overcoming of the forces of cohesion, we still have the gas in the receiver doing work in giving a motion of translation to the mass of gas thrown out into the vacuum.

I think, however, that it can be proved that no work is necessary to set a gas in motion of translation in a vacuum by the following reasoning. Suppose that in a body of gas all the molecules move with the same velocity instead of having, as we assume according to the kinetic theory, velocities varying greatly in magnitude, and that the identical velocity of all the molecules plays in other respects the same part which we attribute to the mean molecular velocity, *e. g.*, that to each degree of temperature of a gas a fixed velocity corresponds, etc. Let that gas be compressed in a receiver and then allowed to enter a vacuous vessel which communicates with the latter. What will happen? To my mind, it can hardly be conceived that anything else could take place than the uniform distribution of the

gas in both vessels, the same temperature obtaining throughout its entire mass. For how could a difference of temperature result when no other action between the molecules is possible than their collisions with one another, collisions which cannot affect the molecule's kinetic energy (the kinetic energy of each molecule being the same according to our supposition). But if it is admitted that in the supposed case the two vessels will be filled uniformly with the gas at the same temperature throughout, it is also admitted that a portion of the gas was set in motion of translation without any work having been done.

The only objection that could be raised to the above reasoning is perhaps this: the gas, while compressed in the receiver, has motion of agitation and, after equilibrium is established upon a portion of the gas having entered the vacuous vessel, it has again the same motion of agitation, but while passing from the receiver into and through the vacuous vessel a portion of the gas had, in addition, motion of translation which must be superimposed on the motion of agitation. There thus seems to be here a plus of energy to be accounted for. But this objection can be met by considering more closely the three stages in time which the phenomenon of the expansion of a gas into a vacuum presents. First, in the compression chamber all the gas has only motion of agitation, then while traversing the vacuous vessel the respective portion of the gas has only or mainly motion of translation at the expense of its original motion of agitation; and lastly, on striking the walls of the empty vessel the incoming gas has its motion of translation reconverted into motion of agitation.

If the above reasoning is correct, it means that just as to set one gas molecule in motion of translation in a vacuum does not require anything else than its own motion of agitation (which will, I believe, be admitted by every one), so with a body of gas.

But if in the hypothetical case no change in the magnitude of the kinetic energy of the individual molecules is required to 'translate' (if I may use the expression) a portion of the molecules, why should it be necessary in the actual case as understood on the basis of the kinetic theory? It is true that we observe here a redistribution of energy and a 'translation' of a portion of the gas, but this 'translation' would have taken place if there were no redistribution of energy.

PETER FIREMAN.

WASHINGTON, D. C.

WILL-MAKING.

TO THE EDITOR OF SCIENCE: The ever-recurring contests of wills, the disputes as to their validity, their meaning in general and particular, the interpretation of their peculiarities and seeming inconsistencies, etc., are such a damage to private comfort and to the public welfare in the highest sense, that any means of lessening the growing evil must be welcomed by all concerned.

As part remedy at least, I would suggest the establishment by each state of a court or other properly constituted body, whose duty and business it should be, upon application, to consider and validate *during the lifetime of the testator* his will, which, after approval could be deposited with the necessary secrecy, as a thoroughly competent legal instrument. To change a will, the same process should be gone through again. This presentation, validation and placing on record should absolutely bar all actions designed to break or alter the will after the death or subsequent incapacity of the testator. The way in which the Torrens land-title has been instituted in some countries is, if not a precedent, an instance of the successful treatment of a kindred difficulty. An unbreakable will might turn out to be as great a boon as an indefeasible title.

ALEXANDER F. CHAMBERLAIN.

CLARK UNIVERSITY, WORCESTER, MASS.,

[It is said of Charles Darwin in the 'Life and Letters': 'He would declare energetically that if he were law-giver no will should be valid that was not published in the testator's lifetime.' It is not clear how a secret will could be validated in the manner suggested by Professor Chamberlain, but there appears to be no reason why it should not be possible to probate a will during the lifetime of the testator. Such legal and moral scandals as

the subversion of the intentions of Stewart, Tilden, Fayerweather and others would thus be rendered impossible.—Editor.]

SHORTER ARTICLES.

SLEEPY GRASS AND ITS EFFECT ON HORSES.

In the Pecos Valley of New Mexico a year ago, a ranchman told me of a strange kind of grass found in the Sacramento Mountains west of there which, from its peculiar effect on horses, is called 'sleepy grass.' He described it as differing from the locoes in merely putting horses into a deep sleep without other symptoms of poison.

The story had a far-away sound and made little impression at the time, but last September, as I was traveling along the crest of the Sacramento Mountains, it came back to me with a new interest.

We had made camp one evening in a beautiful park, bordered with spruces and firs, and covered with tall grass that, with its green base leaves and ripe heads loaded with heavy rye-like grain, offered a tempting feast to our hungry animals. The moment saddles and harness were off, the horses were eagerly feeding. A few minutes later a passing ranchman stopped his team and called over to us, 'Look out there! Your horses are getting sleepy grass,' and added, 'If they get a good feed of that grass you will not get out of here for a week.' We were not prepared to spend a week in that locality, but I was anxious to test the grass, so let the horses feed for a half hour, then brought them up for their oats and picketed them on some short grass on a side hill well out of reach of the sleepy grass.

The following morning just after sunrise the cook called my attention to the attitude of one of the team horses, saying there was 'sure something the matter with old Joe.' The horse was standing on the side hill, asleep, his feet braced wide apart, head high in air, both ears and under lip dropped, a most ridiculous picture of profound slumber. The other horses apparently had not eaten as much of the grass as old Joe, for they were merely dozing in the morning sun and showed signs of life in an occasional shake of the head or switch of the tail. At breakfast time the others woke up to a keen interest in their oats, but old Joe, after being dragged to camp much against his will, preferred to sleep rather than eat, and after pulling back on his rope all the way down to the spring, refused to drink or even lower his head to water. My little saddle mare showed the least signs of the general stupor, so dropping behind with her, I woke the others up pretty thoroughly and brought them into camp on a lope. Later, when in the harness, the team traveled along steadily with some urging, but when we reached Cloudcroft and left the horses in front of the store while getting supplies, their heads dropped, and for an hour they slept soundly. Even my nervy little mare did not move from her tracks, but stood with drooping ears, paying no attention to the unusual surroundings and stir of a town. On starting again the saddle horses responded to the spurs with worried switches of the tail quite different from their usual manner, while the team paid no greater attention to the whip. For the rest of the day our progress was slow, notwithstanding which, the driver called my attention to the fact that the team, and especially old Joe, were sweating profusely. Our saddle horses would sigh with relief when allowed to stop for a moment, and we had many a good laugh at the flapping ears of my companion's horse—a large-eared, raw-boned cayuse which seemed to have lost all control of her usually erect ears.

That night we camped in another park-like valley where sleepy grass was abundant, but took care to picket the horses out of reach of it. They were hungry and all began to feed eagerly, but old Joe soon stopped, braced his feet and relaxed into forgetful slumber. The next morning when we went to bring them in for their grain all were fast asleep.

The stupor lasted about three days, and was too evident and unusual to be attributed to weariness or natural indisposition. We were making easy trips and the horses were in good condition. After it wore off they showed their usual spirit and energy, as well as appetite. The only after-effect was a gaunt appearance, apparently resulting from lack of

energy to get their usual amount of grass. Old Joe had even refused his grain for about half the time.

It should be remembered that our horses had but a small amount of the grass. The ranchmen told us that other travelers coming into the country had been obliged to camp for a week while their horses slept off the effect of a good feed of it, and while its effects usually lasted for a week or ten days, it did no more serious damage than to leave the animals thin from fasting. Stories were told of horses being lost in the mountains and found several days later in the bushes near camp fast asleep.

I have offered no real proof that this particular species of grass is what affected our horses. They undoubtedly ate a dozen other species of grass, as well as some other plants, every day while we were in the mountains. But after our experience I am inclined to give credit to the uniform statements of the ranchmen in regard to it. All agree on the species, on its effects, and to the fact that after one good dose of sleepy grass, horses will never touch it again. This latter statement has ample proof. Horses and cattle are ranging in many of the valleys where it grows in abundance, untouched and full of ripe seed, while the other grasses are cropped close all around it. I did not see horses or cattle touch it except in the case of our own animals and the team of another traveler from the valley, all of which ate it eagerly. They ate both the base leaves and the heads that were full of ripe seeds. I shelled out and ate a handful of the seeds, but without noticeable effect. The ranchmen generally agree that it is the leaves which produce the sleepiness.

I did not hear that cattle were affected by it, but they certainly avoid it, as many were grazing near where it stood untouched.

While this experience was new to me, I find that sleepy grass has long been known to botanists as such, or technically as *Stipa vaseyi*. Something has been known of its effects on horses, but apparently its chemical properties have not yet been determined.

VERNON BAILEY.

THE VERTEBRAL COLUMN OF BRONTOSAURUS.

ALTHOUGH the genus *Brontosaurus* Marsh has been known from the greater part of the skeleton for more than twenty years, many points of interest concerning its structure remain undetermined. The Field Columbian Museum Expedition of 1900 was fortunate in securing a large part of a skeleton of one of these great reptiles in such a state of preservation that the bones of the torso and base of the tail were scarcely disturbed from their relative positions. This splendid specimen, which is now almost ready for exhibition, makes it possible to determine the vertebral formula of the thoracic and anterior caudal regions, as well as many other minor features.

The specimen consists of eleven presacral vertebræ, five coalesced sacral, and twenty-three caudal vertebræ, with pelvis, ribs and chevrons almost intact. The eleventh presacral was exposed and partially broken away when found. From that point backward the thoracic, sacral and caudal vertebræ, as far as caudal XIII., were lying in a close series, with their centra nowhere displaced more than two or three inches. Most of the ribs and many of the chevrons were also found in position.

The specimen throughout agrees very closely, both in size and in character, with Marsh's type, *Brontosaurus excelsus*. However, it shows that with regard to the thoracic region his final restoration was considerably at fault. In fact his first figure* shows the thorax much more nearly correct. Counting the five coalesced vertebræ as sacral, the thoracic series in this specimen is made up of ten rib-bearing vertebræ. The eleventh, as before stated, has been partially lost, but enough remains to show that the transverse process is replaced by a cervical rib. A noticeable reduction in size of the rib facets on presacral X together with the much-reduced neural spines on presacral XI., bears out the conclusion that the latter is the posterior cervical. We may, therefore, conclude that the number of thoracic vertebræ in this genus is ten instead of fourteen as estimated by Marsh.

The crest of the dorsal arch was evidently

* *Am. Jour. Sci.*, Vol. XXVI., pt. I.

just in front of the sacrum, where the dorsal spines reach their greatest length. From this point they rapidly fall away in both the caudal and the thoracic series. In the fourth presacral the first evidence of bifurcation appears in a slight concavity on the posterior margin of the spine. In the eighth, bifurcation is complete, the median spine being replaced by two slender and laterally directed processes. In the eleventh presacral, or posterior cervical, these lateral spines are reduced to mere rudiments.

The anterior caudal series departs less widely from that represented in Marsh's restoration. Indeed, the gradual reduction of the series posteriorly offers no reliable basis of comparison. The first caudal may be readily recognized by the semi-concave, semi-convex anterior surface of the centrum. It is also but little excavated laterally. The four succeeding caudals are more or less excavated at the base of the transverse processes. In one or two instances these fossæ descend deeply into the centra, but as they are sometimes present on one side and absent on the other they can not be regarded as constant characters. However, as Marsh has estimated the first caudal having a solid centrum as caudal IV., it is quite probable that three vertebræ, instead of one, were missing in his specimen from the anterior end of the series. On the other hand, Dr. Osborn has probably erred on the side of estimating the number of anterior caudals as too great, if indeed the specimen described by him * as *Camarasaurus* syn. *Brontosaurus* may be regarded as belonging to this genus at all.

The centra of the anterior caudals are markedly procœlous in form, but as they diminish in size and complexity this character disappears, so that in the region of the fifteenth they become irregularly amphiplatyan. The transverse processes are rapidly reduced in size, from broad flattened plates to peg-like processes, and disappear entirely with the twelfth.

As has been pointed out by Osborn and by Hatcher with regard to *Diplodocus*, the three types of chevrons (viz., the closed arch, the open arch and the double arch types) are all found in *Brontosaurus*, ranging in the order named from the anterior end of the series backward. The presence of a short, stout, closed chevron imbedded in the matrix below the first caudal suggests that the whole series may have been chevron-bearing. As the double arch pattern is also known to occur in *Morosaurus*, the three types may be regarded as characteristic of the Sauropoda.

A complete description of this splendid specimen will be given in an early issue of the museum publications. E. S. Riggs.

Field Columbian Museum,
January 10, 1903.

* *Bull. Amer. Mus. Nat. Hist.*, Vol. X., p. 219.

AMERICAN MUSEUM OF NATURAL HISTORY.

At the annual meeting of the Board of Trustees of the American Museum of Natural History, New York, on Monday evening, February 9, announcement was made in the President's report of many notable accessions to the collections of the Museum during the year 1902. Among the most important accessions are the following:

The Cope collection of fossil reptiles, amphibians and fishes, and the Robinson collection of archeological copper inplements, the two collections being gifts of the President.

Many rare and superb specimens have been added to the J. Pierpont Morgan collections of gems and gem minerals, and the Museum is indebted to the same donor, Mr. Morgan, for a type collection of gold and silver coins of the United States Mint.

The Duke of Loubat has presented a collection of ancient jadeite ornaments from Mexico and a valuable ethnological collection from Brazil.

The material received through the expeditions, supported by the Museum and through special gifts, has yielded gratifying results. Among the noteworthy expeditions are:

The William C. Whitney expedition in search of fossil horses.

The researches carried on in Mexico through the contributions of B. T. Babbitt Hyde and Frederick E. Hyde, Jr.

The archeological research carried on in the

Delaware valley at the expense of Dr. Frederick E. Hyde, and the field work among the vanishing tribes of the North American Indians, supported mainly through the contributions of Mrs. C. P. Huntington and Archer M. Huntington.

The Jesup North Pacific Expedition has yielded a large quantity of material.

The Eastern Asiatic Research expedition, maintained through the assistance of a friend of the Museum, has added to the collections a series of valuable and interesting objects illustrating the culture of China.

The expedition under Andrew J. Stone, who has been collecting specimens of the large fur-bearing animals in the far north, has enriched the Museum collections with many specimens of caribou, bear, deer and sheep, which will be utilized in the preparation of groups of the animals, represented with their natural environment.

A large quantity of material has been received from Commander Robert E. Peary, through the Peary Arctic Club.

The library of the Museum has received many gifts of desirable works, the most noteworthy being a gift of 287 volumes on conchology, for which the Trustees are indebted to Frederick A. Constable.

President Jesup referred to the loss to the Board in the death of Abram S. Hewitt, who had been a Trustee since 1874.

The officers for the year are:

President—Morris K. Jesup (Twenty-third term).

First Vice-President—J. Pierpont Morgan.

Second Vice-President—Professor Henry Fairfield Osborn.

Treasurer—Charles Lanier.

Director—Dr. Hermon C. Bumpus.

Secretary-Assistant Treasurer—John H. Winser.

*THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH.**

THE Rockefeller Institute for Medical Research was founded in 1901, by Mr. John D. Rockefeller, who gave for this purpose the sum of two hundred thousand dollars. The aims of the institute are the promotion of medical research, with especial reference to the prevention and treatment of disease.

It was thought wise by the directors of the institute not, at first, to concentrate the work in any one locality, but to enlist the interest and cooperation of such investigators throughout the country as might be engaged in promising researches or who might enter upon new fields if suitable pecuniary assistance could be afforded them. It was the conviction of the directors that in this way it would be possible not only to stimulate and foster valuable contributions to science, but also to secure important practical suggestions as to the lines along which the institute might most wisely develop.

Among the large number of applications for assistance in carrying on original studies which relate to the cause, prevention and cure of disease, and to the problems upon which new knowledge on these subjects must be based, over twenty have been selected. The directors have secured counsel in these selections from the heads of departments or others in the universities of Harvard, Yale, Johns Hopkins, Pennsylvania, Columbia, New York, Chicago, Michigan, McGill, Wesleyan, California and Western Reserve; and in many of these institutions work has been prosecuted. Two of the Rockefeller fellows have been working in Europe. Some of the workers under these Rockefeller Institute grants, which vary in amount from two hundred to fifteen hundred dollars, have completed and published their investigations; some are still engaged upon them.

It is the purpose of the directors, from time to time, to bring together in the form of volumes of collected reprints, the results of these researches which may be published in various technical journals. An arrangement has been effected by which the institute will assume the publication of the *Journal of Experimental Medicine* which will remain under the editorial supervision of Dr. William H. Welch, professor of pathology in the Johns Hopkins University, and president of the board of directors of the institute.

At the end of the first year of practical

* A statement sent us by the secretary of the institute. Dr. L. Emmett Holt.

work of careful study of the situation, it became clear to the directors that existing institutions in this country, while in many instances carrying on most valuable researches in medicine, do not afford adequate facilities for many phases of investigation which are of the utmost importance and urgency. This is in part due to the lack of sufficient endowment, in part to the large demands made upon the time and energy of the workers by their duties as teachers. It was further evident that such assistance as the institute had thus far been enabled to extend to selected investigators in various parts of the country had fostered work of great actual value, as well as of high promise, and should be perpetuated along similar lines.

The directors, however, were united in the conviction that the highest aims of the institute could not be secured in this way alone. Useful as such individual studies are and important as it is to enlist and to maintain the interest of research workers in established institutions of learning, it is not possible in this way to secure the unity of aim and the coordination and mutual stimulus and support which are essential to the highest achievements in research. These are to be secured, it was believed, only by the centralization of certain lines at least of the work of the institute under a competent head or series of heads of departments, in a fixed place, with adequate equipment and permanent endowment.

There is no lack of men of sufficient training and experience ready to devote their lives to the solution of medical problems which bear directly or indirectly upon the welfare of mankind. The widely open fields of research are many. Some of these relate to the application of existing knowledge to the prevention and cure of disease; others to the development of new knowledge along various lines of science which more than ever before give promise of great significance in the problems of physical life.

In a broad sense, the directions and methods for the study of disease may be classified as morphological, physiological and chemical; and the institute, it was thought, should include departments providing for these divisions of the subject. For the morphological study of disease there should be a complete equipment for pathological-anatomical research. For the physiological study of disease provision should be made for experimental pathology, for pharmacology and therapeutics, for the study of bacteria and other microorganisms with especial reference to their relation to the infectious diseases, and for other investigations in personal and public hygiene, including preventive medicine. Here belong especially the problems of infection and immunity, and here also, in large part, such studies as require access to patients in hospitals. There should be a laboratory, well equipped for investigations in physiological and pathological chemistry.

It was the conviction of the directors that such an institute might wisely add to its aims in the direct increase of the knowledge of disease and its prevention and cure, a phase of activity which should look toward the education of the people in the ways of healthful living, by popular lectures, by hygienic museums, by the diffusion of suitable literature, etc. For, in fact, the existing agencies for medical research for the most part stop short of those direct and widely diffused applications of newly won knowledge upon which the immediate practical fruitage of their work so largely depends.

In order that the causes and treatment of human disease may be studied to the best advantage, it was the opinion of the directors that there should be attached to the institute a hospital for the investigation of special groups of cases of disease. This hospital should be modern and fully equipped, but it need not be large. It should attempt to provide only for selected cases of disease, and the patients would thus secure the advantages of special and skilled attendance and such curative agencies as the institute might develop or foster.

It was thought that an institute for medical research of the largest promise would require a central institution, fully equipped and endowed, and with capacity for growth, in which the more comprehensive studies demanding

the coordinated forces of various phases of science could be carried on from year to year; while at the same time, by means of such grants of assistance as had been offered during the initial year, it should continue to make available the resources of special workers all over the country, as well as in Europe.

In view of the above considerations relating to its future, in June, 1902, Mr. Rockefeller gave to the institute the sum of one million dollars for the purchase of suitable land, the erection of buildings, and the organization of a working force along the broader lines which had been projected. It is the purpose of the directors to proceed at once to the erection of a laboratory building which will provide for the present requirements and will be capable of enlargement as the character and extent of the work of the institute may develop. Negotiations for a suitable plot are now under way.

A small hospital will also be built in the immediate future, which will be maintained in close association with the experimental work of the institute.

Provision will be made in the laboratory building for research in physiological chemistry, pharmacology and therapeutics; in normal and pathological physiology; and in various phases of morphology; and for the study of bacteria and other microorganisms. It is hoped that the laboratory buildings may be completed and ready for the commencement of work in the autumn of 1904.

Dr. Simon Flexner, professor of pathology in the University of Pennsylvania, will direct the scientific work when the building is completed. His colleagues deem it of the highest importance that the institute has been able to secure so eminent an investigator as Dr. Flexner to shape the work of its early years. Dr. Flexner will spend several months abroad while the new buildings are in course of erection.

It is proposed to organize the various sections and departments into which the work of the institute will naturally fall so that each of them, though in a measure autonomous, will still be so closely associated as to favor the conjoint investigation of comprehensive problems. Associated with the head of each of these departments it is proposed to have a staff of trained assistants.

Provision will also be made for research work by a group of trained men, to be designated fellows, scholars, etc., of the institute, under pecuniary grants of varying amounts.

Finally, opportunity will be afforded to suitable investigators, not members of the regular staff of the institute, to pursue special lines of research.

The directors of the institute are:

Dr. William H. Welch, Baltimore; Dr. T. Mitchell Prudden, New York; Dr. Theobald Smith, Boston; Dr. Simon Flexner, Philadelphia; Dr. Hermann M. Biggs, New York; Dr. C. A. Herter, New York; Dr. L. Emmett Holt, New York.

The officers are:

President—Dr. William H. Welch.
Vice-President—Dr. T. Mitchell Prudden.
Secretary—Dr. L. Emmett Holt.
Treasurer—Dr. C. A. Herter.

SCIENTIFIC NOTES AND NEWS.

DR. J. H. VAN'T HOFF, professor of chemistry at the University of Berlin, has been elected a corresponding member of the Academy of Sciences at Munich, and an honorary member of the Philosophical Society of Cambridge.

M. E. MASCART has been elected a member of the International Committee on Weights and Measures.

THE Lucy Wharton Drexel medal of the University of Pennsylvania was presented to Professor F. W. Putnam at the Founder's Day celebration on February 21. The medal was established four years ago, but no awards were made until this year, when four were awarded at one time. The other three to receive the medal are: Professor Petrie for his work at Abydos; Professor Evans for his excavations at Crete; and Professor Hilprecht for work in Babylonia. Hereafter one medal will be awarded each year 'for the best excavations in archeology or for the best publication, based on archeology, by an English-speaking scholar.' Next year the medal will

be awarded by the first four recipients to one whom they deem the most worthy.

Dr. J. Walter Fewkes, of the Bureau of American Ethnology, who has been in Porto Rico since last November, has sent a large number of valuable specimens to Washington.

Messrs. William K. Wright and W. K. Palmer, of the Lick Observatory, left San Francisco on February 28 for Santiago, Chili, where astronomical observations will be made in accordance with the plan we have already announced. The expenses, it will be remembered, are defrayed by Mr. D. O. Mills.

Lieut. Boyd Alexander has returned from an expedition to the Island of Fernando Po in continuation of his survey of the birds of western Africa and the adjacent islands. His collection represents sixty-eight species, of which no fewer than thirty-two are new to science.

Mr. Stewart Culin, recently curator of the Museum of Science and Art of the University of Pennsylvania, has become curator of ethnology to the Museum of the Brooklyn Institute of Arts and Sciences.

Dr. A. S. Grünbaum, F.R.C.P., has accepted the post of director of cancer research at the invitation of the committee appointed to administer the fund initiated for that purpose by a gift of £10,000 from Mr. Sutton Timmis of Liverpool. The work will be carried on at the University College and Royal Infirmary in Liverpool.

Dr. W. H. C. Redeke has been appointed director of the Zoological Station at Helger, Holland, in place of Dr. P. C. C. Hoek, who has become general secretary of the International Bureau of Oceanography at Copenhagen.

Dr. Eduard Zeller, emeritus professor of philosophy at Berlin, has recently celebrated his eighty-ninth birthday.

Dr. J. Bishop Tingle, professor of chemistry at Illinois College, Jacksonville, Ill., has received a grant of $500 from the Carnegie Institution to enable him to continue his investigations of derivatives of camphor and allied compounds.

The Academy of Sciences at Berlin has made appropriations of 2,000 Marks to Professor Landolt and of 1,500 Marks to Dr. Marckwald, both of Berlin, for work in chemistry; of 1,000 Marks to Dr. Danneberg, of Aachen, for work in mineralogy, and of 800 Marks to Professor Kobert, of Rostock, for work in pharmacology.

Dr. H. W. Wiley, chief of the Bureau of Chemistry of the Department of Agriculture gave a lecture before the American Philosophical Society in Philadelphia, on February 6, on 'The Composition and Adulteration of Foods'; before the Society of Medical Jurisprudence at New York, on February 9, on 'The Adulteration of Drugs and Laws Relating Thereto'; before the National Canners' Association at Washington, on February 12, on 'Chemical Problems relating to the Canning Industry'; and before the National Geographic Society at Washington, on February 18, on 'The United States: its Soils and their Products.'

Mrs. Rowland has given to the Johns Hopkins University the library of the late Professor Rowland relating to spectroscopy, and a former student has given a fund of over $5,000 to purchase books on this subject. With these gifts, there will be established a 'Henry A. Rowland memorial library' to contain publications in the field of radiation and spectroscopy. To make the collection complete, and to maintain its usefulness, the cooperation of observatories, laboratories and investigators is necessary. It is requested that sets of official publications, books, reprints of papers on spectroscopy or allied subjects, and photographs of spectra and of apparatus will be contributed to the library, both now and in the future. They may be addressed to the care of Professor Joseph S. Ames, director of the Physical Laboratory, Johns Hopkins University, Baltimore, Md.

Professor Czerny, son-in-law of the late Professor Kussmaul, has had the house at Kandern, where Kussmaul lived in his early years, marked with a tablet with the following inscription: 'Adolf Kussmaul, later Professor

at Erlangen, Heidelberg, Freiburg, and Strassburg, practised here, 1850–1853.'

REAR-ADMIRAL WILLIAM HARKNESS, U.S.N. (retired), the eminent astronomer, president of the American Association for the Advancement of Science in 1893, died on February 28 of typhoid fever, in his sixty-sixth year.

RICHARD JORDAN GATLING, inventor of the gun that bears his name and of various agricultural implements, died on February 26, in his eighty-fourth year.

MRS. M. L. D. PUTNAM, of Davenport, Iowa, died on February 20. Mrs. Putnam was president of the Davenport Academy of Sciences and a fellow of the American Association for the Advancement of Science.

WE regret also to record the death of Dr. Charles Dufour, professor of astronomy at the University of Lausanne, and of Dr. René Thomas Mamert, professor of chemistry at the University of Freiberg, in Switzerland.

MR. HENRY PHIPPS, of New York, has given a further sum of $50,000, making $60,000 in all, for the promotion of scientific work in India. It is said that the money will be used for a Pasteur Institute in southern India and for an agricultural laboratory in Cashmere.

THERE will be a civil service examination on March 24 to fill the position of assistant curator in the division of physical anthropology in the National Museum at a salary of $1,800. On the same day there will be an examination for the position of laboratory assistant in the Bureau of Soils, Department of Agriculture, at a salary ranging from $840 to $1,200.

A BOSTON chapter of the American Institute of Electrical Engineers was established at the Massachusetts Institute of Technology on February 13, Professor Elihu Thomson presiding.

THE United States has been invited to take part in an agricultural congress, which will be held at Rome from April 19 to 23.

THE Davenport Academy of Science is having a loan exhibit of objects illustrating weaving. Among over 250 specimens on exhibition are some rare Aleutian, together with fine Alaskan and Californian baskets. In connection with the basketry exhibit is shown a collection of Navajo blankets, Mexican mats and ethnological specimens from the South Sea Islands and Manila.

THE *Geographical Journal* states that the Swedish expedition which went last summer to Spitzbergen to complete the operations for the measurement of an arc of the meridian, left unfinished the preceding year owing to unfavorable weather conditions, returned during the autumn after successfully accomplishing its task, a junction being effected with the Russian net of triangles in the more southern parts of the group. The operations were begun in 1898, and had, therefore, occupied in all no less than five summers.

WE learn from the London *Times* that in order to encourage investigations into the increase of fertility in soils by the action of bacteria and other micro-organisms, under the influence of mineral manures, with special reference to manuring with basic slag, Verein der Thomasphosphatfabriken has instituted a competition, with prizes amounting to a total of £1,950. Scientific essays and experiments conducted by practical farmers will be admissible in the competition. The method of treatment of the subject is left to the discretion of each competitor. The competition is to be open to all, without regard to nationality. The following five gentlemen have consented to act as judges, any of whom will be pleased to give particular information to intending competitors: Government-Adviser Dr. L. Hiltner, principal of the Royal Agricultural and Bacteriological Institution, Munich; Professor Dr. Alfred Koch, principal of the Royal Agricultural and Bacteriological Institution, the University, Göttingen; Professor Dr. Remy, principal of the Institute for Researches and Bacteriology, the Royal Agricultural University, Berlin; Professor Dr. A. Stutzer, principal of the Royal Agricultural Chemical Institute, the University, Königsberg; and Professor Dr. H. Wilfarth, principal of the Ducal Agricultural Experimental Station, Bernburg. Competitors are requested to send in their essays, written in German, to the association, not later than February 1, 1906, by registered post.

UNIVERSITY AND EDUCATIONAL NEWS.

At the recent meeting of the trustees of Cornell University President Schurman announced an anonymous gift of $150,000 for the establishment of a pension fund.

Mr. James B. Colgate, of New York, has given $100,000 to Colgate University, Hamilton, N. Y., to which he had already given over $1,000,000.

Mr. Andrew Carnegie has given $100,000 to Western Reserve University for the establishment of a school for the training of librarians.

A gift of $250,000 was made last spring to Teachers College, Columbia University, for the construction of a building for physical education and school hygiene. It is now announced that the donor is Mrs. Frederick F. Thompson, one of the trustees of the college.

Last week we announced that Professor Sylvester Waterhouse, at the time of his death emeritus professor of Greek at Washington University, had bequeathed $25,000 to the university, the interest to accumulate until the year 2000, and had made other bequests. We are informed that this is not quite correct, Professor Waterhouse having given $25,000 to Washington University in 1895 on condition that he should be paid five per cent. interest during his life and that the gift should be kept secret until at least one year after his death. The money is to accumulate until the year 2000 or until the fund amounts to $1,000,000. Under somewhat similar conditions Mr. Waterhouse had given $5,000 to Harvard University, to Dartmouth College, to Phillips-Exeter Academy and to the Missouri Historical Society.

Mr. R. B. Keyser, president of the board of trustees of the Johns Hopkins University, has given $5,000 to make plans for improving the new site of the university.

Columbia University receives $10,000 for the establishment of a scholarship by the will of Mrs. Ellen Josephine Banker.

At Cornell University Professor L. H. Bailey has been appointed director of the college of agriculture and dean of faculty of agriculture, to succeed Professor I. P. Roberts, retired; Professor L. M. Dennis, head of the department of chemistry, to succeed Professor Caldwell, retired; Assistant Professors W. R. Orndorff, W. D. Bancroft and E. Merritt have been promoted to professorships of organic and physiological chemistry, physical chemistry and physics, respectively.

At the University of Nebraska, Dr. Raymond G. Clap has been appointed professor of physical education, and Dr. Ralph S. Lillie instructor in physiology; Dr. Edgar L. Hinman has been promoted to a full professorship and Dr. Thadeus L. Bolton to an adjunct professorship in philosophy; Robert E. Moritz has been promoted to an assistant professorship in mathematics, and Burton E. Moore to a full professorship of physics.

Dr. D. J. Cunningham, F.R.S., professor of anatomy in the University of Dublin, has been elected to the chair of anatomy in the University of Edinburgh, vacant by the promotion of Sir William Turner to the principalship. Dr. Cunningham is a graduate of the University of Edinburgh and was for some years demonstrator in anatomy under Sir William Turner.

At Cambridge University Mr. T. Manners-Smith, Downing, and Dr. H. W. Marett Tims, King's, have been appointed demonstrators of anatomy. Mr. W. A. Cunnington, Christ's, has been appointed to the university table in the Naples Zoological Station. Dr. D. MacAlister, Professor Woodhead and Dr. Nuttall have been appointed representatives of the university at the International Congress of Hygiene and Demography to be held at Brussels in September. The following have been appointed electors to the respective chairs specified: chemistry, Dr. T. E. Thorpe; anatomy, Dr. Allbutt; botany, Mr. A. Sedgwick; Downing (medicine), Dr. A. Macalister; zoology, Dr. D. MacAlister; physics, Lord Rayleigh; physiology, Professor G. S. Woodhead; surgery, Dr. A. Macalister; pathology, Dr. W. H. Gaskell.

Professor Loewinson-Lessing, of Dorpat, has been elected professor of geology in the Polytechnic Institute at St. Petersburg.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 13, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*ON THE FOUNDATIONS OF MATHEMATICS.**

THE American Mathematical Society gives its retiring president the privilege of speaking on whatever he may have at heart. Accordingly, this afternoon I propose to consider with you some matters of importance—indeed, perhaps of fundamental importance—in the development of mathematics in this country; and it will duly appear in what non-technical sense I am speaking 'On the Foundations of Mathematics.'

A VIEW.

Abstract Mathematics.—The notion within a given domain of defining the objects of consideration rather by a body of properties than by particular expressions or intuitions is as old as mathematics itself. And yet the central importance of the notion appeared only during the last century—in a host of researches on special theories and on the foundations of geometry and analysis. Thus has arisen the general point of view of what may be called *abstract mathematics.* One comes in touch with the literature very conveniently by the mediation of Peano's *Revue des Mathématiques.* The Italian school of Peano and the *Formulaire Mathématique,* published in connection with the *Revue,*

* Presidential address delivered before The American Mathematical Society at its ninth annual meeting, December 29, 1902.

are devoted to the codification in Peano's symbolic language of the principal mathematical theories, and to researches on abstract mathematics. General interest in abstract mathematics was aroused by Hilbert's Gauss-Weber Festschrift of 1899: 'Ueber die Grundlagen der Geometrie,' a memoir rich in results and suggestive in methods; I refer to the reviews by Sommer,* Poincaré,† Halsted,‡ Hedrick§ and Veblen.‖

We have as a basal science logic, and as depending upon it the special deductive sciences which involve undefined symbols and whose propositions are not all capable of proof. The symbols denote either classes of elements or relations amongst elements. In any such science one may choose in various ways the system of undefined symbols and the system of undemonstrated or primitive propositions, or postulates. Every proposition follows from the postulates by a finite number of logical steps. A careful statement of the fundamental generalities is given by Padoa in a paper¶ before the Paris Congress of Philosophy, 1900.

Having in mind a definite system of undefined symbols and a definite system of postulates, we have first of all the notion of the compatibility of these postulates; that is, that it is impossible to prove by a finite number of logical steps the simultaneous validity of a statement and its contradictory statement; in the next place, the question of the independence of the postulates or the irreducibility of the system of postulates; that is, that no postulate is provable from the remaining postulates. Padoa introduces the notion of the irreducibility of the system of undefined symbols. A system of undefined symbols is said to be reducible if for one of the symbols, X, it is possible to establish, as a logical consequence of the assumption of the validity of the postulates, a nominal or symbolic definition of the form $X = A$, where in the expression A there enter only the undefined symbols distinct from X. For the purpose of practical application, it seems to be desirable to modify the definition so as to call the system of undefined symbols reducible if there is a nominal definition $X = A$ of one of them X in terms of the others such that in any interpretation of the science the postulates retain their validity when instead of the initial interpretation of the symbol X there is placed the interpretation A of that symbol. If the system of symbols is reducible in the sense of the original definition it is in the sense of the new definition, but not necessarily conversely, as appears for instance from the following example, occurring in the foundations of geometry.

Hilbert uses the following undefined symbols: 'point,' 'line,' 'plane,' 'incidence' of point and line, 'incidence' of point and plane, 'between,' and 'congruent.' Now it is possible to give for the symbol 'plane' a symbolic definition in terms of the other undefined symbols—for instance, a plane is a certain class of points (as Peano showed in 1892), or again, a plane is a certain class of lines; while the notion 'incidence' of point and plane receives convenient definition. It is apparent from the fact that these definitions may be given in these two ways that Hilbert's system of undefined symbols is not in Padoa's sense irreducible, at least, in so far as the symbols 'plane,' 'incidence' of point and plane are

* *Bull. Amer. Math. Soc.* (2), vol. 6 (1900), p. 287.

† *Bull. Sciences Mathém.*, vol. 26 (1902), p. 249.

‡ *The Open Court*, September, 1902.

§ *Bull. Amer. Math. Soc.* (2), vol. 9 (1902), p. 158.

‖ *The Monist*, January, 1903.

¶ 'Essai d'une théorie algébrique des nombres entiers, précédé d'une Introduction logique à une théorie déductive quelconque,' *Bibliothèque du Congrès International de Philosophie*, vol. 3, p. 309.

concerned—while it is equally clear that these symbols are in the abstract geometry superfluous.

In his dissertation on euclidean geometry, Mr. Veblen, following the example of Pasch and Peano, takes as undefined symbols 'point' and 'between,' or 'point' and 'segment.' In terms of these two symbols alone he expresses a set of independent fundamental postulates of euclidean geometry, in the first place developing the projective geometry, and then as to congruence relating himself to the point of view of Klein in his 'Erlangen Programm,' whereby the group of movements of euclidean geometry enters as a certain subgroup of the group of collineations of projective geometry. Here arises an interesting question as to the sense in which the undefined symbol 'congruence' is superfluous in the euclidean geometry based upon the symbols 'point,' 'between.' One sees at once that a definition of 'congruence' involves parametric points in its expression, while on the other hand a definition of the system of all 'planes,' that is, of the general concept 'plane,' involves no such parametric elements. But, again, just as there exist distinct definitions of 'congruence,' owing to a variation of the parametric points, so there exist distinct definitions of the general concept 'plane,' as was indicated a moment ago. One has the feeling that the state of affairs must be as follows: In any interpretation of, say, Hilbert's symbols, wherein the postulates of Hilbert are valid, every valid statement which does not involve the symbol 'plane' in direct connection with the general logical symbol (=) of symbolic definition, remains valid when we modify it in accordance with either of the definitions of 'plane' previously referred to. On the other hand, this state of affairs does not hold for the symbol 'congruence.' The proof of the former statement would seem to involve fundamental logical niceties.

The compatibility and the independence of the postulates of a system of postulates of a special deductive science have been up to this time always made to depend upon the self-consistency of some other deductive science; for instance, geometry depends thus upon analysis, or analysis upon geometry. The fundamental and still unsolved problem in this direction is that of the direct proof of the compatibility of the postulates of arithmetic, or of the real number system of analysis. (To the society this morning Dr. Huntington exhibited two sets of independent postulates for this real number system.) This is the second of the twenty-three problems listed by Hilbert in his address before the Paris Mathematical Congress of 1900.

The Italian writers on abstract mathematics for the most part make use of Peano's symbolism. One may be tempted to feel that this symbolism is not an essential part of their work. It is only right to state, however, that the symbolism is not difficult to learn, and that there is testimony to the effect that the symbolism is actually of great value to the investigator in removing from attention the concrete connotations of the ordinary terms of general and mathematical language. But of course the essential difficulties are not to be obviated by the use of any symbolism, however delicate.

Indeed the question arises whether the abstract mathematicians in making precise the metes and bounds of logic and the special deductive sciences are not losing sight of the evolutionary character of all life-processes, whether in the individual or in the race. Certainly the logicians do not consider their science as something now fixed. All science, logic and mathematics included, is a function of the epoch—all science, in its ideals as well as in its achieve-

ments. Thus with Hilbert let a special deductive or mathematical science be based upon a finite number of symbols related by a finite number of compatible postulates, every proposition of the science being deducible by a finite number of logical steps from the postulates. The content of this conception is far from absolute. It involves what presuppositions as to general logic? What is a finite number? In what sense is a postulate—for example, that any two distinct points determine a line—a single postulate? What are the permissible logical steps of deduction? Would the usual syllogistic steps of formal logic suffice? Would they suffice even with the aid of the principle of mathematical induction, in which Poincaré finds* the essential synthetic element of mathematical argumentation the basis of that generality without which there would be no science? In what sense is mathematical induction a single logical step of deduction?

One has then the feeling that the carrying out in an absolute sense of the program of the abstract mathematicians will be found impossible. At the same time, one recognizes the importance attaching to the effort to do precisely this thing. The requirement of rigor tends toward essential simplicity of procedure, as Hilbert has insisted in his Paris address, and the remark applies to this question of mathematical logic and its abstract expression.

Pure and Applied Mathematics.—In the ultimate analysis for any epoch, we have general logic, the mathematical sciences,† that is, all special formally and abstractly deductive self-consistent sciences, and the natural sciences, which are inductive and informally deductive. While this classification may be satisfactory as an ideal one, it fails to recognize the fact that in mathematical research one by no means confines himself to processes which are mathematical according to this definition; and if this is true with respect to the research of professional mathematicians, how much more is it true with respect to the study, which should throughout be conducted in the spirit of research, on the part of students of mathematics in the elementary schools and colleges and universities. I refer to the articles* of Poincaré on the rôle of intuition and logic in mathematical research and education.

It is apparent that this ideal classification can be made by the devotee of science only when he has reached a considerable degree of scientific maturity, that perhaps it would fail to appeal to non-mathematical experts, and that it does not accord with the definitions given by practical working mathematicians. Indeed, the attitude of practical mathematicians toward this whole subject of abstract mathematics, and especially the symbolic form of abstract mathematics, is not unlike that of the practical physicist toward the whole subject of theoretic mathematics, and in turn not unlike that of the practical engineer toward the whole subject of theoretical physics and mathematics. Furthermore, every one understands that many of the most important advances of pure mathematics have arisen in connection with investigations originating in the domain of natural phenomena.

Practically then it would seem desirable

* 'Sur la nature du raisonnement mathématique,' *Revue de Métaphysique et de Morale*, vol. 2 (1894), pp. 371–384.

† Of which none is at present known to exist.

* 'La logique et l'intuition dans la science mathématique et dans l'enseignement,' *L'Enseignement Mathématique*, vol. 1 (1899), pp. 157–162. 'Du rôle de l'intuition et de la logique en mathématiques,' *Compte Rendu du Deuxième Congrès International des Mathématiciens*, Paris [1900], 1902, pp. 115–130. 'Sur les rapports de l'analyse pure et de la physique mathématique,' Conference, Zurich, 1897; *Acta Mathematica*, vol. 21, p. 238.

for the interests of science in general that there should be a strong body of men thoroughly possessed of the scientific method in both its inductive and its deductive forms. We are confronted with the questions: What is science? What is the scientific method? What are the relations between the mathematical and the natural scientific processes of thought? As to these questions, I refer to articles and addresses of Poincaré,* Boltzmann† and Burkhardt,‡ and to Mach's 'Science of Mechanics' and Pearson's 'Grammar of Science.'

Without elaboration of metaphysical or psychological details, it is sufficient to refer to the thought that the individual, as confronted with the world of phenomena in his effort to obtain control over this world, is gradually forced to appreciate a knowledge of the usual coexistences and sequences of phenomena, and that science arises as the body of formulas serving to epitomize or summarize conveniently these usual coexistences and sequences. These formulas are of the nature of more or less exact descriptions of phenomena; they are not of the nature of explanations. Of all the relations entering into the formulas of science, the fundamental mathematical notions of number and measure and form were among the earliest, and pure mathematics in its ordinary acceptation may be understood to be the systematic development of the properties of these notions, in accordance with conditions prescribed by physical phenomena. Arithmetic and geometry, closely united in mensuration and trigonometry, early reached a high degree of advancement. But after the development of the generalizing literal notations of algebra, and largely in response to the insistent demands of mechanics, astronomy and physics, the seventeenth century, binding together arithmetic and geometry infinitely more closely, created analytic geometry and the infinitesimal calculus, those mighty methods of research whose application to all branches of the theoretical and practical physical sciences so fundamentally characterizes the civilization of to-day.

The eighteenth century was devoted to the development of the powers of these new instruments in all directions. While this development continued during the nineteenth century, the dominant note of the nineteenth century was that of critical reorganization of the foundations of pure mathematics, so that, for instance, the majestic edifice of analysis was seen to rest upon the arithmetic of positive integers alone. This reorganization and the consequent course of development of pure mathematics were independent of the question of the application of mathematics to the sister sciences. There has thus arisen a chasm between pure mathematics and applied mathematics. There have not been lacking, however, influences making toward the bridging of this chasm; one thinks especially of the whole influence of Klein in Germany and of the École Polytechnique in France. As a basis of union of the pure mathematicians and the applied mathematicians, Klein has throughout emphasized the importance of a clear understanding of the relations between those two parts of mathematics which are conveniently called 'mathematics of precision' and 'mathematics of approximation,' and I refer especially to his latest work of this

* In addition to those already cited: 'On the Foundations of Geometry,' *The Monist*, vol. 9, October, 1898, pp. 1–43. 'Sur les principes de la mécanique,' *Bibliothèque du Congrès International de Philosophie*, vol. 3, pp. 457–494.

† 'Ueber die Methoden der theoretischen Physik,' *Dyck's Katalog mathematischer und mathematisch-physikalischer Modelle, Apparate und Instrumente*, pp. 89–98, Munich, 1892.

‡ 'Mathematisches und naturwissenschaftliches Denken,' *Jahresbericht der Deutschen Math.-Ver.*, vol. 11 (1902), pp. 49–57.

character, 'Anwendung der Differential und Integral-Rechnung auf Geometrie: Eine Revision der Principien' (Göttingen, summer semester, 1901, Teubner, 1902). This course of lectures is designed to present particular applications of the general notions of Klein, and, furthermore, it is in continuation of the discussion between Pringsheim and Klein and others, as to the desirable character of lectures on mathematics in the universities of Germany.

Elementary Mathematics.—This separation between pure mathematics and applied mathematics is grievous even in the domain of elementary mathematics. In witness, in the first place: The workers in physics, chemistry and engineering need more practical mathematics; and numerous text-books, in particular, on calculus, have recently been written from the point of view of these allied subjects. I refer to the works by Nernst and Schoenflies,* Lorentz† Perry‡ and Mellor,§ and to a book on the very elements of mathematics now in preparation by Oliver Lodge.

In the second place, I dare say you are all familiar with the surprisingly vigorous and effective agitation with respect to the teaching of elementary mathematics which is at present in progress in England, largely under the direction of John Perry, professor of mechanics and mathematics of the Royal College of Science, London, and chairman of the Board of Examiners of the Board of Education in the subjects of engineering, including practical plane and solid geometry, applied mechanics, practical mathematics, in addition to more technical subjects, and in this capacity in charge of the education of some hundred thousand apprentices in English night schools. The section on Education of the British Association had its first session at the Glasgow meeting, 1901, and the session was devoted to the consideration, in connection with the section on Mathematics and Physics, of the question of the pedagogy of mathematics, and Perry opened the discussion by a paper on 'The Teaching of Mathematics.' A strong committee under the chairmanship of Professor Forsyth, of Cambridge, was appointed 'to report upon improvements that might be effected in the teaching of mathematics, in the first instance, in the teaching of elementary mathematics, and upon such means as they think likely to effect such improvements.' The paper of Perry, with the discussion of the subject at Glasgow, and additions including the report of the committee as presented to the British Association at its Belfast meeting, September, 1902, are collected in a small volume, 'Discussion on the Teaching of Mathematics,' edited by Professor Perry (Macmillan, second edition, 1902).*

One should consult the books of Perry, 'Practical Mathematics,'† 'Applied Mechanics,'‡ 'Calculus for Engineers'§ and 'England's Neglect of Science,'‖ and his

* Nernst und Schoenflies, 'Einführung in die mathematische Behandlung der Naturwissenschaften (Munich and Leipsic, 1895); the basis of Young and Linebarger's 'Elements of Differential and Integral Calculus,' New York, 1900.

† Lorentz, 'Lehrbuch der Differential- und Integralrechnung,' Leipsic, 1900.

‡ Perry, 'Calculus for Engineers' (second edition, London, E. Arnold, 1897); German translation by Fricke (Teubner, 1902). Cf. also the citations given later on.

§ Mellor, 'Higher Mathematics for Students of Chemistry and Physics, with special reference to Practical Work,' Longmans, Green & Co., 1902, pp. xxi + 543.

* Cf. also 'Report on the Teaching of Elementary Mathematics issued by the Mathematical Association,' G. Bell & Sons, London, 1902.

† Published for the Board of Education by Eyre and Spottiswoode, London, 1899.

‡ D. Van Nostrand Co., New York, 1898.

§ Second edition, London, E. Arnold, 1897.

‖ T. Fisher Unwin, London, 1900.

address* on 'The Education of Engineers' —and furthermore the files from 1899 on of the English journals, *Nature, School World, Journal of Education* and *Mathematical Gazette.*

One important purpose of the English agitation is to relieve the English secondary school teachers from the burden of a too precise examination system, imposed by the great examining bodies; in particular, to relieve them from the need of retaining Euclid as the sole authority in geometry, at any rate with respect to the sequence of propositions. Similar efforts made in England about thirty years ago were unsuccessful. Apparently the forces operating since that time have just now broken forth into successful activity; for the report of the British Association committee was distinctly favorable, in a conservative sense, to the idea of reform, and already noteworthy initial changes have been made in the regulations for the secondary examinations by the examination syndicates of the universities of Oxford, Cambridge and London.

The reader will find the literature of this English movement very interesting and suggestive. For instance, in a letter to *Nature* (vol. 65, p. 484, March 27, 1902) Perry mildly apologizes for having to do with the movement whose immediate results are likely to be merely slight reforms, instead of thoroughgoing reforms called for in his pronouncements and justified by his marked success during over twenty years as a teacher of practical mathematics. He asserts that the orthodox logical sequence in mathematics is not the only possible one; that, on the contrary, a more logical sequence than the orthodox one (because one more possible of comprehension by students) is based upon the notions underlying the infinitesimal calculus taken as axioms; for instance, that a map may be drawn to scale; the notions underlying the many uses of squared paper; that decimals may be dealt with as ordinary numbers. He asserts as essential that the boy should be *familiar* (by way of experiment, illustration, measurement and by every possible means) with the ideas to which he applies his logic; and moreover that he should be thoroughly *interested* in the subject studied; and he closes with this peroration:

> "'Great God! I'd rather be
> A pagan, suckled in a creed outworn.'

I would rather be utterly ignorant of all the wonderful literature and science of the last twenty-four centuries, even of the wonderful achievements of the last fifty years, than not to have the sense that our whole system of so-called education is as degrading to literature and philosophy as it is to English boys and men."

As a pure mathematician, I hold as the most important suggestion of the English movement the suggestion of Perry's, just cited, that by emphasizing steadily the practical sides of mathematics, that is, arithmetic computations, mechanical drawing and graphical methods generally, in continuous relation with problems of physics and chemistry and engineering, it would be possible to give very young students a great body of the essential notions of trigonometry, analytic geometry, and the calculus. This is accomplished, on the one hand, by the increase of attention and comprehension obtained by connecting the abstract mathematics with subjects which are naturally of interest to the boy, so that, for instance, all the results obtained by theoretic process are capable of check by laboratory process, and, on the other hand, by a diminution of emphasis on the sys-

* In opening the discussion of the sections on Engineering and on Education at the Belfast, 1902, meeting of the British Association; published in SCIENCE, November 14, 1902.

tematic and formal sides of the instruction in mathematics. Undoubtedly many mathematicians will feel that this decrease of emphasis will result in much, if not irreparable, injury to the interests of mathematics. But I am inclined to think that the mathematician with the catholic attitude of an adherent of science, in general (and at any rate with respect to the problems of the pedagogy of elementary mathematics there would seem to be no other rational attitude) will see that the boy will be learning to make practical use in his scientific investigations—to be sure, in a naïve and elementary way—of the finest mathematical tools which the centuries have forged; that under skilful guidance he will learn to be interested not merely in the achievements of the tools, but in the theory of the tools themselves, and that thus he will ultimately have a feeling towards his mathematics extremely different from that which is now met with only too frequently—a feeling that mathematics is indeed itself a fundamental reality of the domain of thought, and not merely a matter of symbols and arbitrary rules and conventions.

The American Mathematical Society.—The American Mathematical Society has, naturally, interested itself chiefly in promoting the interests of research in mathematics. It has, however, recognized that those interests are closely bound up with the interests of education in mathematics. I refer in particular to the valuable work done by the committee appointed, with the authorization of the Council, by the Chicago section of the society, to represent mathematics in connection with Dr. Nightingale's committee of 1899 of the National Educational Association in the formulation of standard curricula for high schools and academies, and to the fact that two committees are now at work, one appointed in December, 1901, by the Chicago Section, to formulate the desirable conditions for the granting, by institutions of the Mississippi valley, of the degree of Master of Arts for work in mathematics, and the other appointed by the society at its last summer meeting to cooperate with similar committees of the National Educational Association and of the Society for the Promotion of Engineering Education, in formulating standard definitions of requirements in mathematical subjects for admission to colleges and technological schools; and furthermore I refer to the fact that (although not formally) the society has made a valuable contribution to the interests of secondary education in that the College Entrance Examination Board has as its secretary the principal founder of the society. I have accordingly felt at liberty to bring to the attention of the society these matters of the pedagogy of elementary mathematics, and I do so with the firm conviction that it would be possible for the society, by giving still more attention to these matters, to further most effectively the highest interests of mathematics in this country.

A VISION.

An Invitation.—The pure mathematicians are invited to determine how mathematics is regarded by the world at large, including their colleagues of other science departments and the students of elementary mathematics, and to ask themselves whether by modification of method and attitude they may not win for it the very high position in general esteem and appreciative interest which it assuredly deserves.

This general invitation and the preceding summary view invoke this vision of the future of elementary mathematics in this country.

The Pedagogy of Elementary Mathematics.—We survey the pedagogy of elementary mathematics in the primary schools, in the secondary schools and in the junior colleges (the lower collegiate years). It is, however, understood that

there is a movement for the enlargement of the strong secondary schools, by the addition of the two years of junior college work and by the absorption of the last two or three grades of the primary schools, into institutions more of the type of the German gymnasia and the French lycée;* in favor of this movement there are strong arguments, and among them this, that in such institutions, especially if closely related to strong colleges or universities, the mathematical reforms may the more easily be carried out.

The fundamental problem is that of *the unification of pure and applied mathematics.* If we recognize the branching implied by the very terms 'pure,' 'applied,' we have to do with a special case of *the correlation of different subjects* of the curriculum, a central problem in the domain of pedagogy from the time of Herbart on. In this case, however, the fundamental solution is to be found rather by way of indirection—by arranging the curriculum so that throughout the domain of elementary mathematics the branching be not recognized.

The Primary Schools.—Would it not be possible for the children in the grades to be trained in power of observation and experiment and reflection and deduction so that always their mathematics should be directly connected with matters of thoroughly concrete character? The response is immediate that this is being done to-day in the kindergartens and in the better elementary schools. I understand that serious difficulties arise with children of from nine to twelve years of age, who are no longer contented with the simple, concrete methods of earlier years and who, nevertheless, are unable to appreciate the more abstract methods of the later years. These difficulties, some say, are to be met by allowing the mathematics to enter only implicitly in connection with the other subjects of the curriculum. But rather the material and methods of the mathematics should be enriched and vitalized. In particular, the grade teachers must make wiser use of the foundations furnished by the kindergarten. The drawing and the paper folding must lead on directly to systematic study of intuitional geometry, including the construction of models and the elements of mechanical drawing, with simple exercises in geometrical reasoning.* The geometry must be closely connected with the numerical and literal arithmetic. The cross-grooved tables of the kindergarten furnish an especially important type of connection, viz., a conventional graphical depiction of any phenomenon in which one magnitude depends upon another. These tables and the similar cross-section blackboards and paper must enter largely into all the mathematics of the grades. The children are to be taught to represent, according to the usual conventions, various familiar and interesting phenomena and to study the properties of the phenomena in the pictures: to know, for example, what concrete meaning attaches to the fact that a graph curve at a certain point is going down or going up or is horizontal. Thus the problems of percentage—interest, etc.—have their depiction in straight line or broken line graphs.

* As to the mathematics of these institutions, one may consult the book on 'The Teaching of Mathematics in the Higher Schools of Prussia' (New York, Longmans, Green & Co., 1900) by Professor Young, and the article (*Bulletin Amer. Math. Soc.* (2), vol. 6, p. 225) by Professor Pierpont.

* Here I refer to the very suggestive paper of Benchara Branford, entitled 'Measurement and Simple Surveying. An Experiment in the Teaching of Elementary Geometry' to a small class of beginners of about ten years of age (*Journal of Education*, London, the first part appearing in the number for August, 1899).

The Secondary Schools.—Pending the reform of the primary schools, the secondary schools must advance independently. In these schools at present, according to one type of arrangement, we find algebra in the first year, plane geometry in the second, physics in the third, and the more difficult parts of algebra and solid geometry, with review of all the mathematics, in the fourth.

Engineers* tell us that in the schools algebra is taught in one water-tight compartment, geometry in another, and physics in another, and that the student learns to appreciate (if ever) only very late the absolutely close connection between these different subjects, and then, if he credits the fraternity of teachers with knowing the closeness of this relation, he blames them most heartily for their unaccountably stupid way of teaching him. If we contrast this state of affairs with the state of affairs in the solid four years' course in Latin, I think we are forced to the conclusion that the organization of instruction in Latin is much more perfect than that of the instruction in mathematics.

The following question arises: *Would it not be possible to organize the algebra, geometry and physics of the secondary school into a thoroughly coherent four years' course,* comparable in strength and closeness of structure with the four years' course in Latin? (Here under physics I include astronomy and the more mathematical and physical parts of physiography.) It would seem desirable that, just as the systematic development of theoretical mathematics is deferred to a later period, likewise much of theoretical physics might well be deferred. Let the physics also be made thoroughly practical. At any rate, so far as the instruction of boys is concerned, the course should certainly have its character largely determined by the conditions which would be imposed by engineers. What kind of two or three years' course in mathematics and physics would a thoroughly trained engineer give to boys in the secondary school? Let this body of material postulated by the engineer serve as the basis of the four years' course. Let the instruction in the course, however, be given by men who have received expert training in mathematics and physics as well as in engineering, and let the instruction be so organized that with the development of the boy, in appreciation of the practical relations, shall come simultaneously his development in the direction of theoretical physics and theoretical mathematics.

Perry is quite right in insisting that it is scientifically legitimate in the pedagogy of elementary mathematics to take a large body of basal principles instead of a small body, and to build the edifice upon the larger body for the earlier years, reserving for the later years the philosophic criticism of the basis itself and the reduction of the basal system.

* Why is it that one of the sanest and best-informed scientific men living, a man not himself an engineer, can charge mathematicians with killing off every engineering school on which they can lay hands? Why do engineers so strongly urge that the mathematical courses in engineering schools be given by practical engineers?

And why can a reviewer of 'Some Recent Books of Mechanics' write with truth: "The students' previous training in algebra, geometry, trigonometry, analytic geometry and calculus as it is generally taught has been necessarily quite formal. These mighty algorithms of formal mathematics must be learned so that they can be applied with readiness and precision. But with mechanics comes the application of these algorithms, and formal, do-by-rote methods, though often possible, yield no results of permanent value. How to elicit and cultivate thought is now of primary importance"? (E. B. Wilson, *Bulletin Amer. Math. Soc.*, October, 1902.) But is it conceivable that in any part of the education of the student the problem of eliciting and cultivating thought should not be of primary importance?

To consider the subject of geometry in all briefness: with the understanding that proper emphasis is laid upon all the concrete sides of the subject, and that furthermore from the beginning exercises in informal deduction* are introduced increasingly frequently, when it comes to the beginning of the more formal deductive geometry why should not the students be directed each for himself to set forth a body of geometric fundamental principles, on which he would proceed to erect his geometric edifice? This method would be thoroughly practical and at the same time thoroughly scientific. The various students would have different systems of axioms, and the discussions thus arising naturally would make clearer in the minds of all precisely what are the functions of the axioms in the theory of geometry. The students would omit very many of the axioms, which to them would go without saying. The teacher would do well not to undertake to make the system of axioms thoroughly complete in the abstract sense. "Sufficient unto the day is the precision thereof." The student would very probably wish to take for granted all the ordinary properties of measurement and of motion, and would be ready at once to accept the geometrical implications of coordinate geometry. He could then be brought with extreme ease to the consideration of fundamental notions of the calculus as treated concretely, and he would find those notions delightfully real and powerful, whether in the domain of mathematics or of physics or of chemistry.

* In an article shortly to appear in the *Educational Review*, on 'The Psychological and the Logical in the Teaching of Geometry,' Professor John Dewey, calling attention to the evolutionary character of the education of an individual, insists that there should be no abrupt transition from the introductory, intuitional geometry to the systematic, demonstrative geometry.

To be sure, as Study has well insisted, for a thorough comprehension of even the elementary parts of euclidean geometry the non-euclidean geometries are absolutely essential. But the teacher is teaching the subject for the benefit of the students, and it must be admitted that beginners in the study of demonstrative geometry can not appreciate the very delicate considerations involved in the thoroughly abstract science. Indeed, one may conjecture that, had it not been for the brilliant success of Euclid in his effort to organize into a formally deductive system the geometric treasures of his times, the advent of the reign of science in the modern sense might not have been so long deferred. Shall we then hold that in the schools the teaching of demonstrative geometry should be reformed in such a way as to take account of all the wonderful discoveries which have been made—many even recently—in the domain of abstract geometry? And should similar reforms be made in the treatment of arithmetic and algebra? To make reforms of this kind, would it not be to repeat more gloriously the error of those followers of Euclid who fixed his 'Elements' as a textbook for elementary instruction in geometry for over two thousand years? Every one agrees that professional mathematicians should certainly take account of these great developments in the technical foundations of mathematics, and that ample provision should be made for instruction in these matters; and on reflection, every one agrees further that this provision should be reserved for the later collegiate and university years.

The Laboratory Method.—This program of reform calls for the development of a thoroughgoing laboratory system of instruction in mathematics and physics, a principal purpose being as far as possible to develop on the part of every student the true spirit of research, and an appreciation,

practical as well as theoretic, of the fundamental methods of science.

In connection with what has already been said, the general suggestions I now add will, I hope, be found of use when one enters upon the questions of detail involved in the organization of the course.

As the world of phenomena receives attention by the individual, the phenomena are described both graphically and in terms of number and measure; the number and measure relations of the phenomena enter fundamentally into the graphical depiction, and furthermore the graphical depiction of the phenomena serves powerfully to illuminate the relations of number and measure. This is the fundamental scientific point of view. Here under the term graphical depiction I include representation by models.

To provide for the needs of laboratory instruction, there should be regularly assigned to the subject two periods, counting as one period in the curriculum.

As to the possibility of effecting this unification of mathematics and physics in the secondary schools, objection will be made by some teachers that it is impossible to do well more than one thing at a time. This pedagogic principle of concentration is undoubtedly sound. One must, however, learn how to apply it wisely. For instance, in the physical laboratory it is undesirable to introduce experiments which teach the use of the calipers or of the vernier or of the slide rule. Instead of such uninteresting experiments of limited purpose, the students should be directed to extremely interesting problems which involve the use of these instruments, and thus be led to learn to use the instruments as a matter of course, and not as a matter of difficulty. Just so the smaller elements of mathematical routine can be made to attach themselves to laboratory problems, arousing and retaining the interest of the students. Again, everything exists in its relations to other things, and in teaching the one thing the teacher must illuminate these relations.

Every result of importance should be obtained by at least two distinct methods, and every result of especial importance by two essentially distinct methods. This is possible in mathematics and the physical sciences, and thus the student is made thoroughly independent of all authority.

All results should be checked, if only qualitatively or if only 'to the first significant figure.' In setting problems in practical mathematics (arithmetical computation or geometrical construction) the teacher should indicate the amount or percentage of error permitted in the final result. If this amount of percentage is chosen conveniently in the different examples, the student will be led to the general notion of closer and closer approximation to a perfectly definite result, and thus in a practical way to the fundamental notions of the theory of limits and of irrational numbers. Thus, for instance, uniformity of convergence can be taught beautifully in connection with the concrete notion of area under a monotonic curve between two ordinates, by a figure due to Newton, while the interest will be still greater if in the diagram area stands for work done by an engine.

The teacher should lead up to an important theorem gradually in such a way that the precise meaning of the statement in question, and further, the practical—*i. e.*, computational or graphical or experimental—truth of the theorem is fully appreciated; and, furthermore, the importance of the theorem is understood, and, indeed, the desire for the formal proof of the proposition is awakened, before the formal proof itself is developed. Indeed, in most cases, much of the proof should be secured

by the research work of the students themselves.

Some hold that absolutely individual instruction is the ideal, and a laboratory method has sometimes been used for the purpose of attaining this ideal. The laboratory method has as one of its elements of great value the flexibility which permits students to be handled as individuals or in groups. The instructor utilizes all the experience and insight of the whole body of students. He arranges it so that the students consider that they are studying the subject itself, and not the words, either printed or oral, of any authority on the subject. And in this study they should be in the closest cooperation with one another and with their instructor, who is in a desirable sense one of them and their leader. Instructors may fear that the brighter students will suffer if encouraged to spend time in cooperation with those not so bright. But experience shows that just as every teacher learns by teaching, so even the brightest students will find themselves much the gainers for this cooperation with their colleagues.

In agreement with Perry, it would seem possible that the student might be brought into vital relation with the fundamental elements of trigonometry, analytic geometry and the calculus, on condition that the whole treatment in its origin is and in its development remains closely associated with thoroughly concrete phenomena. With the momentum of such practical education in the methods of research in the secondary school, the college students would be ready to proceed rapidly and deeply in any direction in which their personal interests might lead them. In particular, for instance, one might expect to find effective interest on the part of college students in the most formal abstract mathematics.

For all students who are intending to take a full secondary school course in preparation for colleges or technological schools, I am convinced that the laboratory method of instruction in mathematics and physics, which has been briefly suggested, is the best method of instruction—for students in general, and for students expecting to specialize in pure mathematics, in pure physics, in mathematical physics or astronomy, or in any branch of engineering.

Evolution, not Revolution.—In contemplating this reform of secondary school instruction we must be careful to remember that it is to be accomplished as an evolution from the present system, and not as a revolution of that system. Even under the present organization of the curriculum the teachers will find that much improvement can be made by closer cooperation one with another; by the introduction, so far as possible, of the laboratory two-period plan; and in any event by the introduction of laboratory methods: laboratory record books, cross-section paper, computational and graphical methods in general, including the use of colored inks and chalks; the cooperation of students; and by laying emphasis upon the comprehension of propositions rather than upon the exhibition of comprehension.

The Junior Colleges.—Just as the secondary schools should begin to reform without waiting for the improvement of the primary schools, so the elementary collegiate courses should be modified at once without waiting for the reform of the secondary schools. And naturally, in the initial period of reform, the education in each higher domain will involve many elements which later on will be transferred to a lower domain.

Further, by the introduction into the junior colleges of the laboratory method of instruction it will be possible for the colleges and universities to take up a duty which for the most part has been neglected

in this country. For, although we have normal schools and other training schools for those who expect to teach in the grades, little attention has as yet been given to the training of those who will become secondary school teachers. The better secondary schools to-day are securing the services of college graduates who have devoted special attention to the subjects which they intend to teach, and as time goes on the positions in these schools will as a rule be filled (as in France and Germany) by those who have supplemented their college course by several years of university work. Here these college and university graduates proceed at once to their work in the secondary schools. Now in the laboratory courses of the junior college, let those students of the senior college and graduate school who are to go into the teaching career be given training in the pedagogy of mathematics according to the laboratory system; for such a student the laboratory would be a laboratory in the pedagogy of mathematics; that is, he would be a colleague-assistant of the instructor. By this arrangement, the laboratory instruction of the colleges would be strengthened at the same time that well equipped teachers would be prepared for work in the secondary schools.

The Freedom of the Secondary Schools.—The secondary schools are everywhere preparing students for colleges and technological schools, and whether the requirements of those institutions are expressed by way of examination of students or by way of the conditions for the accrediting of schools or teachers, the requirements must be met by the secondary schools. The stronger secondary school teachers too often find themselves shackled by the specific requirements imposed by local or by collegiate authorities. Teaching must become more of a profession. And this implies not only that the teacher must be better trained for his career, but that also in his career he be given with greater freedom greater responsibility. To this end closer relations should be established between the teachers of the colleges and those of the secondary schools; standing provisions should be made for conferences as to improvement of the secondary school curricula and in the collegiate admission requirements; and the leading secondary school teachers should be steadily encouraged to devise and try out plans looking in any way toward improvement.

Thus the proposed four years' laboratory course in mathematics and physics will come into existence by way of evolution. In a large secondary school, the strongest teachers, finding the project desirable and feasible, will establish such a course alongside the present series of disconnected courses—and as time goes on their success will in the first place stimulate their colleagues to radical improvements of method under the present organization and finally to a complete reorganization of the courses in mathematics and physics.

The American Mathematical Society.—Do you not feel with me that the American Mathematical Society, as the organic representative of the highest interests of mathematics in this country, should be directly related with the movement of reform? And, to this end, that the society, enlarging its membership by the introduction of a large body of the strongest teachers of mathematics in the secondary schools, should give continuous attention to the question of improvement of education in mathematics, in institutions of all grades? That there is need for the careful consideration of such questions by the united body of experts, there is no doubt whatever, whether or not the general suggestions which we have been considering this afternoon turn out to be desirable and practicable. In case the question of pedagogy

does come to be an active one, the society might readily hold its meetings in two divisions—a division of research and a division of pedagogy.

Furthermore, there is evident need of a national organization having its center of gravity in the whole body of science instructors in the secondary schools; and those of us interested in these questions will naturally relate ourselves also to this organization. It is possible that the newly formed Central Association of Physics Teachers may be the nucleus of such an organization.

CONCLUSION.

The successful execution of the reforms proposed would seem to be of fundamental importance to the development of mathematics in this country. I urge that individuals and organizations proceed to the consideration of the general question of reform with all the related questions of detail. Undoubtedly in many parts of the country improvements in organization and methods of instruction in mathematics have been making these last years. All persons who are, or may become, actively interested in this movement of reform should in some way unite themselves, in order that the plans and the experience, whether of success or failure, of one may be immediately made available in the guidance of his colleagues.

I may refer to the centers of activity with which I am acquainted. Miss Edith Long, in charge of the Department of Mathematics in the Lincoln (Neb.) High School, reports upon the experience of several years in the correlation of algebra, geometry and physics, in the October, 1902, number of the *Educational Review*. In the Lewis Institute of Chicago, Professor P. B. Woodworth, of the Department of Electrical Engineering, has organized courses in engineering principles and electrical engineering in which are developed the fundamentals of practical mathematics. The general question came up at the first meeting* (Chicago, November, 1902) of the Central Association of Physics Teachers, and it is to be expected that this association will enlarge its functions in such a way as to include teachers of mathematics and of all sciences, and that the question will be considered in its various bearings by the enlarged association. At this meeting informal reports were made from the Bradley Polytechnic Institute of Peoria, the Armour Institute of Technology of Chicago, and the University of Chicago. The question is evoking much interest in the neighborhood of Chicago.

I might explain how I came to be attracted to this question of pedagogy of elementary mathematics. I wish, however, merely to express my gratitude to many mathematical and scientific friends, in particular, to my Chicago colleagues, Mr. A. C. Lunn and Professor C. R. Mann, for their cooperation with me in the consideration of these matters, and further to express the hope that we may secure the active cooperation of many colleagues in the domains of science and of administration, so that the first carefully chosen steps of a really important advance movement may be taken in the near future.

I close by repeating the questions which have been engaging our attention this afternoon.

In the development of the individual in his relations to the world, there is no initial separation of science into constituent parts, while there is ultimately a branching into the many distinct sciences.

* Subsequent to the meeting of organization in the spring of 1902. Mr. Chas. H. Smith of the Hyde Park High School, Chicago, is president of the Association. Reports of the meetings are given in *School Science* (Ravenswood, Chicago).

The troublesome problem of the closer relation of pure mathematics to its applications: can it not be solved by indirection, in that through the whole course of elementary mathematics, including the introduction to the calculus, there be recognized in the organization of the curriculum no distinction between the various branches of pure mathematics, and likewise no distinction between pure mathematics and its principal applications? Further, from the standpoint of pure mathematics: will not the twentieth century find it possible to give to young students during their impressionable years, in thoroughly concrete and captivating form, the wonderful new notions of the seventeenth century?

By way of suggestion these questions have been answered in the affirmative, on condition that there be established a thoroughgoing laboratory system of instruction in primary schools, secondary schools and junior colleges—a laboratory system involving a synthesis and development of the best pedagogic methods at present in use in mathematics and the physical sciences.

Eliakim Hastings Moore.
University of Chicago.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION C, CHEMISTRY.

The meetings of Section C were held jointly with those of the American Chemical Society on December 29, 30 and 31, in the Medical Building of Columbian University. The meetings on the first two days were in charge of the officers of the American Chemical Society, Dr. Ira Remsen, president of the society, presiding. On the third day Vice-President Baskerville presided. The address of the retiring vice-president, Dr. H. A. Weber, on 'Incomplete Observations,' was delivered on Monday, December 29. The newly elected sectional officers are:

Vice-President—Dr. W. D. Bancroft, of Cornell University.

Secretary—C. L. Parsons, of Durham, N. H.

Members of the Sectional Committee—A. S. Wheeler, E. C. Franklin, M. T. Bogert, L. P. Kinnicutt and L. Kahlenberg.

Among the papers read were the following:

Corrosion of some Ancient Coins: F. P. Dunnington, University of Virginia, Charlottesville, Va.

About fifteen years ago the late Judge Victor Clay Barringer was living in Alexandria, Egypt, when an extensive fire occurred. After this fire he bought from a native a mass which appeared to consist of corroded copper, which he was told had been obtained from a hole in a wall where a building had been demolished in the conflagration. This compacted green cylindrical mass of about twenty pounds weight was kept as a hearth ornament, and not examined until it recently came into the possession of Dr. Paul B. Barringer, of the University of Virginia. The mass then bore the imprint of the woven bag in which it had been confined and proved to be composed of coins in various stages of corrosion.

The author was requested to clean off a number of the coins, of which there were probably 500, and so far as examined, all prove to have belonged to the reigns of the Cæsars and to have had the same composition and approximately the same weight, about fifteen grams each. The unaltered red metal consists of silver and copper, containing, as shown by several samples, almost exactly one part of silver to four of copper, which, when partially attacked by dipping in acid, loses a portion of copper and leaves a larger proportion of silver on the surface, and thereafter continues to 'wear' as a white metal, evidently having passed as 'silver coin.'

The crust of malachite which firmly bound these pieces together varied in thickness up to two millimeters, and within this there was a layer of red oxide of copper of similar thickness which is almost free of silver, containing but about one per cent. Inside of these two crusts there remained more or less of a dark spongy mass of silver, retaining a little oxide of copper which adhered to the unchanged alloy, and in some instances the latter had entirely disappeared, so that this residue of the coin was fragile while still partly retaining the imprint of the coin. The manner in which the silver was concentrated is of decided interest.

From the contents and circumstances of this find these coins had no doubt been thus stored away for nearly 1,900 years, and yet on most of them the lettering and even the dates may be deciphered.

A Convenient Form of Table for Calculations of Chemical Weights: F. P. DUNNINGTON, University of Virginia.

The author, having frequent occasion to check calculations of the amounts of substances from the weights made by students in quantitative analysis, has constructed a table to enable him quickly to obtain such results. A description of this is given to the section as a proposed accessory in teaching, which may prove instructive to the pupil and helpful to the teacher.

Upon coordinate paper 500 by 400 mm. the 500 mm. abscissa is counted as 1,000, and there is laid off upon the (vertical) ordinate the length corresponding to the figure expressing the amount of body sought for each 1,000 parts of the substance found. A straight line is then drawn from the origin to this point, as 798 for the copper in 1,000 of CuO, or 247 for the chlorine in silver chloride.

Similarly a diagonal line is drawn from the origin for each such form in which bodies are weighed. If, then, one reads off upon the abscissa the measure corresponding to any weight of substance found, the length of the ordinate at that point which is cut off by the corresponding diagonal gives directly the amount of the body sought. For instance, .679 of MnS gives .429 of Mn.

The Action of Unsymmetrical Hydrazines on the Chlorine Derivatives of the Quinones of the Benzene Series: WILLIAM MCPHERSON, W. L. DUBOIS and C. P. LINVILLE.

The unsymmetrical acyl phenyl hydrazines react with the different chlor-quinones in the following ways: (1) A regular condensation may take place forming the corresponding hydrazones, which on saponification yield oxyazo-compounds. (2) A hydrogen atom of the quinone together with a hydrogen atom of NH_2 group of the hydrazine may be removed by the oxidizing action of the quinone, forming a hydrazino compound. (3) A chlorine atom of the quinone may combine with a hydrogen atom of the NH_2 group of the hydrazine, a hydrazino compound being formed with the evolution of hydrochloric acid.

Some New Phenomena Exhibited by Soap Solutions: H. W. HILLYER.

As the formation of bubbles is dependent on the low surface tension of soap solution, so the emulsifying power of soap solutions is largely dependent on the low surface tension between the soap solution and the oily matter removed by it. This lowering of the surface tension is, within certain limits, nearly proportional to the amount of soap in solution. Neither of the hydrolytic products of soap, *i. e.,* alkali or fatty acid, causes this lowering of the surface tension; it is a measure of the amount of *soap* present. Emulsification is

dependent almost directly on the smallness of the surface tension, and this largely explains the cleansing power of soap. A practical soap test from the consumer's standpoint is clearly indicated, but not yet fully worked out.

Charts, diagrams and specimens were shown.

The Composition of Spirits Produced from Grain, and the Changes Undergone by the Same when Stored in Wooden Packages: Charles A. Crampton, Int. Rev., Treasury Dept., Washington, D. C.

Analyses are given of samples of rye and bourbon whiskies, taken each year from packages set aside in government warehouses, for the purpose of determining the effect of time upon the composition of the spirits. The purpose of the experiments is to obtain analytical data upon which genuine whiskies aged without foreign addition can be distinguished from spurious spirits made by coloring matter and artificial flavors to alcohol or cologne spirits. The present paper is a preliminary report of the results obtained for the first four years of storage. The experiments will be continued and complete results and conclusions published at some future date.

Some Double Salts of Organic Acids: Jas. Lewis Howe, Lexington, Va.

Aside from the chrom-oxalates, and oxalates of the platinum metals, few complex salts of organic acids have been studied. A qualitative investigation shows that quite a number of other acids form similar salts. A series of chrom-malonates is described. Attempts made to prepare similar complex salts of trivalent cobalt by electrolytic oxidation. Several of the double cobalto-salts are not oxidized by the electric current. A series of double cobalto-malonates were prepared and are described. These are oxidized to complex cobalti-malonates, and these are now being studied.

Preparation of Standard Solutions of Sulphuric Acid by Direct Dilution: Arthur John Hopkins.

According to the table of Marignac the coefficient of expansion for sulphuric acid of sp. gr. 1,263 is found to be constant between 15° and 20°. Accordingly a stock acid is prepared as near to sp. gr. 1.263 as possible, and its exact specific gravity accurately determined.

A table is prepared for this stock acid showing at different working temperatures the exact volume necessary to dilute to one liter in order to prepare, *e. g.*, a tenth-normal acid. This table is prepared from the work of Lunge and Isler on the valuation of acid of different specific gravities and from the work of Marignac, allowance being made for the expansion of glass.

The preparation of a tenth-normal acid, consists in allowing to flow from a salibrated burette the volume of acid, indicated in the table for the working temperature, into a flask known to contain exactly one liter, and diluting to the mark.

Condensation of Triphenylmethyl to Hexaphenylethane: M. Gomberg, Ann Arbor, Mich.

It has been established that certain halogen derivatives have the power to condense triphenylmethyl to the saturated hydrocarbon hexaphenylethane.

Methods for the Examination of Bitumens and their Determination and Separation: Clifford Richardson, Long Island City, N. Y. Read by title.

In the course of fifteen years' experience, in the application of bitumens in the industries, a large number of methods for the examination and determination of this material have been developed, and are de-

scribed in the paper as a contribution to the literature of the subject.

Portland Cement, Considered as a Solid Solution: CLIFFORD RICHARDSON, Long Island City, N. Y. Read by title.

While the literature on the subject of the constitution of Portland cement is very extensive, in reviewing the same the writer has discovered that the conclusions which have been arrived at are neither uniform nor supported by satisfactory evidence of a synthetic nature. He has, therefore, prepared in the laboratory all those silicates and silico-aluminates which are supposed, according to the theory of various writers, to occur in Portland cement clinker. The results of a study of these preparations under the microscope, by petrographic methods, and in their relations to water, show that many of the theories heretofore advanced are unsound, and the Portland cement must be considered to be a type of solid solution, as it presents features quite similar to those found in alloys of the metals.

A Characterization, Classification and Nomenclature of Native Bitumens: CLIFFORD RICHARDSON, Long Island City, N. Y. Read by title.

This paper has been written because of the appointment of a committee, by the International Association for Testing Materials, on the subject of the nomenclature of bitumen.

Many classifications of the native bitumens have been attempted in the past, but they have been based upon insufficient data. During the past ten years the writer has had an opportunity to examine a very large number of native bitumens, and to compare them with type specimens, which are now generally unavailable, through the exhaustion of the mines. The evidence accumulated in this way forms the basis of the proposals contained in the paper.

In the course of the examination grahamite, which has hitherto been described as only coming from West Virginia, has been found to occur in an easily recognizable form in Colorado, Indian Territory, Cuba, Trinidad and Mexico; albertite, in Utah and several other localities; and various types of asphalt in some 200 or 300 different localities.

The evidence thus obtained has been carefully analyzed, and the following classification of the native bitumens deduced:

BITUMENS:
- *Gas:*
  - Natural gas.
  - Marsh gas.
- *Petroleum.*
  - Paraffine oils.
    - Rich in sulphur derivatives.
    - Poor in sulphur derivatives.
  - Cyclic oils.
    - Russian, stable polymethylenes.
    - Californian, asphaltic polymethylenes.
  - Mixed oils.
    - Containing both paraffine and cyclic hydrocarbons.
- *Maltha.*
- *Solid Bitumens:*
  - Originating in paraffine hydrocarbons.
    - Ozocerite, hatchetite, etc.
  - Originating in cyclic hydrocarbons.
    - Terpenes, fossil resins, amber, etc.
  - Polymethylenes and their derivatives.
    - Gilsonites.
    - Asphalts, including glance pitch.
    - Grahamites (asphaltites).
  - Individual species.
    - Manjak.
  - Uvalde County, Texas, bitumen, etc.
  - The grahamites rapidly shade into the pyrobitumens.

Pyrobitumens:

Practically insoluble in chloroform or heavy petroleum hydrocarbons.

1. Derived from petroleum.
   Albertite, with varieties called nigrite, etc.
   Elaterite.
   Wurtzelite.
2. Derived from direct metamorphosis of vegetable growth.
   Anthracite.
   Bituminous coal.
   Lignite.
   Peat?

The following papers were also read:

Some of the Work of the Bio-Chemic Division, Department of Agriculture: E. A. de Schweinitz.

Does Cholesterol Occur in Corn Oil? A. H. Gill.

Miley's Color Photography: W. G. Brown.

The Composition of Fresh and Canned Pineapples: L. S. Munson and L. M. Tolman.

Chemical Composition of some Tropical Fruits and Fruit Products: E. M. Chase, L. S. Munson and L. M. Tolman.

Nature of the Work of the Bureau of Chemistry, Department of Agriculture: H. W. Wiley.

Iodine Absorption of Oils; Comparison of Methods: L. M. Tolman and L. S. Munson.

The Relation of the Specific Gravity of Urine to the Solids Present: John H. Long.

Derivatives of Isoapiol and Isosafrol: F. J. Pond. Read by title.

Report of the Committee on Atomic Weights: F. W. Clarke.

Report of the International Committee on Atomic Weights: F. W. Clarke.

On the Need of Systematic Action regarding the Question of Substitution and Adulteration: Leon L. Watters. Read by title.

The Chemical Work of the Bureau of Soils, Department of Agriculture: Frank K. Cameron.

The Action of Metallic Magnesium on Aqueous Solutions: Louis Kahlenberg.

Action upon Metals of Solutions of Hydrochloric Acid in Various Solvents: Harrison E. Patten.

A Proposed Method of Examining Wood Treated to Resist Fire: C. F. McKenna.

An Electric Test Retort: C. F. McKenna.

The Basic Sulphates of Beryllium: Chas. Lathrop Parsons.

The Picrates of the Rare Earths: L. M. Dennis and W. C. Geer.

The Chemical Work of the U. S. Geological Survey: F. W. Clarke.

A Method for the Colorimetric Determination of Phosphates and Silicates when Both are Present: Oswald Schreiner.

A New (?) Meteorite from Augusta County, Virginia: H. D. Campbell and Jas. Lewis Howe.

A Volumetric Method for the Determination of Chromic Acid in Chrome Pigments: E. E. Ewell.

Suggested Improvement in Chlorine Determination: Chas. Baskerville.

The Determination of the Hydrocarbons in Illuminating Gas: L. M. Dennis and J. G. O'Neill.

Reduction with Soluble Anodes: Wilder D. Bancroft.

Solubility Curves for Magnesium Carbonate in Aqueous Solutions of Sodium Chloride, Sodium Sulphate and Sodium Carbonate: Frank K. Cameron and Atherton Seidell.

The Optical Rotating Power of Camphor Dissolved in Inorganic Solvents: Phosphorus Trichloride, Sulphur Dioxide, Sulphur Monochloride: HERMAN SCHLUNDT.

Report of Committee on Atomic Weight of Thorium: CHAS. BASKERVILLE.

New Syntheses in the Phenmiazine Group: MARSTON TAYLOR BOGERT.

Some Picryl Derivatives of Phenols: H. W. HILLYER.

Nomenclature of Elements and Radicals: W. G. BROWN.

Hydrochloric Acid as an Electrolytic Solvent: E. C. FRANKLIN.

H. N. STOKES,
Secretary.

SCIENTIFIC BOOKS.

The Development of the Human Body, A Manual of Human Embryology. By J. PLAYFAIR McMURRICH. With two hundred and seventy illustrations. 12mo. Pp. xvi + 527.

The author in his preface describes his book as 'an attempt to present a concise statement of the development of the human body and a foundation for the proper understanding of the facts of anatomy.' This attempt has been so far successful that the volume is certainly the best short treatise on human embryology in English, and is not surpassed by any of the text-books in foreign languages. It has the distinguishing merit of including a number of important results from recent investigations, which have as yet made their way into no other manual.

The work is really shorter and more condensed than might be supposed from the number of pages, for the type used is large and open and the illustrations, owing to their large size, take up much space. Some of the figures, like Fig. 54, are unnecessarily large. They are, on the whole, well printed, although the ink used is too heavy to give the best effect. The selection of figures has been excellent. Except for a series of diagrams, very few of them are original, by far the majority of the illustrations being copies, not, one is glad to note, from previous text-books, but from the best recent researches.

The author's style is well adapted to his purpose, for it is both concise and clear, revealing, indeed, a marked talent for lucid explanations of the complicated changes which occur in such rapid succession in the embryo, and which render the study of embryology so difficult.

The book would have certainly gained very much had it been less a compilation from well-chosen authorities, and more the outcome of the author's personal study of human embryos. As a compilation it is to be praised warmly, but one misses somehow that vividness of exposition which direct familiarity with preparations, sections and dissections alone can impart to morphological descriptions. One misses also the security of judgment which can be derived from first-hand and intimate acquaintance with the object. To this cause we attribute the author's failure to utilize at all adequately our knowledge of the histogenesis of the nervous system, to consider the relation of the nails to the stratum lucidum, to give any mention of the meninges which offer such striking pictures in sections of embryos, to remember that a mucous membrane always comprises epithelium and mesoderm (cf. p. 79), to describe correctly the degeneration of the glandular epithelium in the pregnant uterus (p. 151, 153), etc.

There are certain errors which mar the work. In the history of germ-cells it is stated positively that the germ-cells produce the spermatozoa, but so far as we know this has not been proved as yet by direct observation to be true of any animal. It is surely no longer correct to speak (p. 122) of the 'branchiomeres' as divisions of the ventral mesoderm, since they arise, so far as yet observed, always from the dorsal segments. It is stated (p. 153) that the decidua serotina 'loses its epithelium very early'—but portions of the epithelium are always persistent. Or again the statement that the processes of the vertebræ and ribs are developed in the intermuscular septa hardly concords with the actual history.

In a new edition, which ought certainly soon to be demanded, two omissions might be advantageously repaired, by adding accounts of the development of the ear bones and of the pulmonary arteries.

The defects, of which some examples have been given, can not any of them be regarded as fundamental. Some such defects are inevitable in a first edition of a text-book dealing with a science, like embryology, in which research is so active that almost every week brings important additions to knowledge of the subject. The only part of the work which seems to the reviewer radically inadequate is that on the formation of the germ-layers.

Professor McMurrich's volume will be eagerly welcomed by students and teachers alike, and its special distinction is the thorough recognition it displays of the morphologically essential aspects of embryology. It ought to exert a wide and helpful influence on the advancement of anatomical science in America.

C. S. Minot.

Field Astronomy for Engineers. By George C. Comstock. New York, Wiley & Sons. 1902. Pp. x + 202. Price, $2.50.

Wiley & Sons have just published an excellent text-book on astronomy written by Professor George C. Comstock, professor of astronomy in the University of Wisconsin, a text-book which undoubtedly will meet with cordial approval from that body of teachers whose duty it is to teach astronomy in technical schools. For many years there existed no concise manual of the subject, the teacher being obliged either to use an elaborate treatise like Chauvenet's, or else employ the unsatisfactory method of presenting the subject entirely by lectures. The present work is the third attempt to supply the deficiency, other similar publications of recent date being those of J. F. Hayford, formerly of Cornell University and now of the U. S. Coast Survey, and of W. W. Campbell, director of the Lick Observatory.

The peculiarity and advantage of the present book are that it omits entirely that portion of the astronomical theory and instrumental niceties beyond the needs of engineering students and, on the other hand, lays special stress on the methods by which only sufficient precision is attained to meet engineering requirements. This general plan of the author enables him to discuss, and he does it with much skill, the question of the inter-relation of accuracy of results with instrumental manipulation, and should give the student a clear insight into the proper methods and formulæ to use on any particular occasion. At the same time the author emphasizes the necessity of methodical computation and insists on a habit of checks, so desirable a habit for engineers in all kinds of computations. In some cases it may be necessary to elaborate verbally some of the theory involved, and to explain, as doubtless the author does to his own classes, much of the instrumental manipulation, so that the book is essentially one to be used by an instructor whose own astronomical training includes much not in the book; but as this is always, at least theoretically, the case, it should not stand as a criticism against the book.

The plan of the book includes, after a discussion of the fundamental concepts of coordinates and the transformation of one system into another and of the various methods of noting them, methods of observation and computation for the determination of time, latitude and azimuth. Each determination is carried out according to the requirements, either roughly, approximately or accurately, in each case modifying the formulæ and the use of instruments as required. For example, for the rough determination of time, use is made of an engineer's transit to observe on Polaris at any instant, the correction to the meridian being given by the use of tables. For the approximate determination, the method given is that of making a series of altitude observations with a sextant on a known star or on the sun when that body is near the prime vertical. For the accurate determination, the method of double altitudes is explained, and a whole chapter is devoted to discussing the transit instrument with its errors and corrections. In each of these cases, as well as in the similar series for latitude and azimuth, the detail of work, the

proper form for notes, suggestions for computations, and the probable error of the result are all given in a satisfactory manner.

Altogether, the book is a careful evidence of a thorough appreciation of the needs of engineering students and of the comprehensive knowledge of the distinguished author.

H. N. OGDEN.

CORNELL UNIVERSITY.

PROFESSOR HEILPRIN ON MONT PELÉE.

THE twentieth century Pompeii in Martinique attracted men of science from all points of the compass. Notes have been published by Lacroix in Paris, Flett and Anderson in London and Hovey in New York, and magazine articles by Russell, Hill, Diller, Curtis and others have familiarized the public with the main facts. Two books of note have appeared, the one by a distinguished traveller and correspondent describing vividly and accurately a layman's impressions of the phenomena and the wreck. The second, entitled 'Mont Pelée and the Tragedy of Martinique,'* is by a well-known geologist and geographer, Angelo Heilprin, and his work is the first book that purports to be a scientific study.

The book was published in December, 1902, and the author had left the field only three months before. In view of this fact the work is a remarkable piece of rapid book-making, well executed by the publishers, and illustrated with half-tone photographs. It is essentially the journal of an explorer, with records compiled in the field of the disasters of May 7 and 8, and four scientific essays. The subjects treated are the author's impressions of Martinique, a description of the ruins of St. Pierre, the narrative of the last days of the city, the author's travels in the interior, his ascent of Pelée at the end of May and his second visit to Martinique in August. Professor Heilprin personally observed the great eruption of August 30, and from a distance he saw the eruption in St. Vincent September 3. His experience in August is especially valuable and unique, because at that time he kept the only scientific record.

* J. B. Lippincott Co., Philadelphia, 1903, pp. 336.

The scientific chapters deal with a comparison of St. Pierre and Pompeii, the geography of Mont Pelée, volcanic relations of the Caribbean basin and the phenomena of the eruptions. In the first of these Pliny's account of the Vesuvian eruption of 79 is discussed; Dion Cassius and later historians refer the destruction of life and property in Pompeii to ashes, cinders and gases. The tumble of ruins in Pompeii has commonly been attributed to earthquakes, but it is possible that there too a destroying blast annihilated the population almost instantly, as in St. Pierre; this accounts for bodies found in attitudes of action or indifference to danger. Heilprin questions the decapitation of Monte Somma at the time of the eruption of 79; he calls attention to Pliny's description of the phenomena as follows: 'On the land side a dark and horrible cloud charged with combustible matter suddenly broke and shot forth a long trail of fire in the nature of lightning, but in larger flashes.' And again, "I looked back; a thick dark vapor just behind us rolled along the ground like a torrent and followed us. The ashes now began falling, although in no considerable quantity." The similarity of this description to that of bystanders in the case of the Caribbean eruption is remarkable. The fact that Pompeiian bodies are largely without clothing, and were huddled together in basements, and that pottery and glassware have been found deformed and discolored, suggests that there was a hurricane blast and conflagration similar to the one which destroyed St. Pierre.

It is questionable whether the Lac des Palmistes, on the summit of Mont Pelée, was really a crater lake. Heilprin concludes that the greater part of the water of this shallow pool after the first eruption was steamed off by the heated ejecta that were thrown into it. These are in part angular blocks of andesite, trachyte and diorite, with here and there scattered boulders of large size and composite character, representing the ancient stock of the volcano. This conclusion is a significant one, contrasted with the supposition of Drs. Flett and Anderson, who were sent out by the Royal Society, that a great

column of molten lava rose to the orifice and exploded. In this place Professor Heilprin apparently holds to the view that the materials ejected are comminuted country rock—an opinion heartily endorsed by the present reviewer. The crater is described as occupying the entire basin of the ancient Étang Sec, and this lay in a gorge distinct from that other head-water tributary of the Rivière Blanche, known as the Rivière Claire, where in 1851 a number of vents opened and ejected ashes. While this is doubtless true, it is probable that all these gorges are now united in the present great amphitheater filled by the new cone. Professor Heilprin recognizes the difficulty attending all surmises as to the exact location of the opening whence came the destroying blast; but he believes it most probable 'that the blast issued from the basal floor of the basin, rather than from a constructing cone.' He states that the lower discharges were always more violent and paroxysmal than those from the upper cone, and that they carried the heaviest charges of ash, sometimes to heights of two miles or more. In this there is no suggestion of a vent low down on the mountain slope, but merely the difference between the base and the summit of the new cone. Violent discharge from the side of the cone has also been noted by Lacroix, and this characteristic is a common one; the ancient crater of Soufrière in St. Vincent, as described in the chronicles of 1812, had a central cone and lakes at the side. The present crater in St. Vincent, when visited by the reviewer on May 31, showed most violent activity on the southeast side of the great cauldron, rather than in its middle. In the center beneath the boiling waters of the pool, there is probably to-day a cone similar to the one on Mont Pelée, representing the direct back-fall of the heaviest materials ejected vertically.

In discussing the volcanic relations of the Caribbean basin, Professor Heilprin follows Suess in the belief that the Caribbean Sea is comparable with the Mediterranean as an area of depression, surrounded by mountain ridges, the islands of the Antilles being in the main merely disrupted parts of a once 'continuous land area.' It is hard to follow him confidently when he states that the volcanic activity of these islands belongs 'to a period of no great geological activity—perhaps nowhere more ancient than the middle tertiary.' Hill has shown clearly that in miocene time there was the most notable orogenic movement in tertiary Caribbean history, and active vulcanism dates probably from the beginning of the eocene. The Suess theory that the Caribbean-Gulf basins are great subsiding areas which 'break, squeeze and press, and as a resultant lands are folded up and volcanic discharges brought to the surface,' is simple and attractive, but in no way proved. The same may be said of the philosophy which links volcanic eruptions on one side of an ocean, with earthquakes on the other that chance to be contemporaneous, or nearly so. It is strange that a colossal seismic disturbance that would bring about correlated phenomena in Guatemala, St. Vincent and Martinique should have no effect whatever on other vents along the same line of fissures as those of these islands. It seems safer to regard such large generalization with a distrustful eye, and to keep in mind earth scale when we speak of 'the outer crust or shell of the globe as resting on a molten interior.' The horizontal scale of the Caribbean Sea, in proportion to the vertical relief of the tiny volcanic blisters, is so enormous that it seems safe to treat the little volcanic fissures very superficially. We know nothing of the earth's 'interior,' nor even of a 'shell.' All that geologists know of rocks can hardly be called a film, in proportion to the great unknown globe within. While the author's view on these points may be open to question, we entirely agree with his opinion that there is no evidence of any recent decrease of volcanic activity in the Caribbean region, and he might well go further and question whether there has been diminution since prehistoric times; human time, like human measure of space, is inadequate for determining such a question.

In the discussion of the phenomena, presumably the statement on page 272 that the 'sweep of the blast could not have been less than from one to two miles an hour' is a

misprint. The statement that 'pumice and bombs prove the existence of a molten magma which rises well into the throat of the volcano,' may be questioned, for ancient glassy tuffs and pumice are abundant in the old agglomerates of Martinique, and the bombs are old rocks merely melted on the surface. The estimate of amount of ash sediment discharged, based in part on Russell's expression of the cubical content of a steam cloud, is full of fallacy. The argument is as follows: If a single cloud has a capacity of four billion cubic feet, is charged with one per cent. of solid matter, and is regularly replaced every five minutes by another cloud of the same size, the total discharge of solid matter per day is 11,520,000,000 cubic feet. This is one and a half times the discharge of the Mississippi River per year, and on this basis the discharge of Pelée is greater than that of all the rivers of the world combined, for the same period of time. This argument is concluded with the question, 'what becomes of the void that is being formed in the interior?' The defect in this sort of reasoning lies in the assumption that a primary eruption is continuous for days or even hours. There have been a few moments of violent outburst at certain intervals, which were undoubtedly explosions from great depth, and may be called primary eruption. Secondary explosion continues for weeks in the intervals, and is occasioned by the contact of superficial water and hot deposits. Obviously such explosions are only working over the same material, yet they occasion tremendous puffs that rise many thousand feet, and perfectly simulate deep-seated processes. Professor Heilprin has failed to discriminate primary and secondary eruption when he talks of Mt. Pelée being 'in a condition of forceful activity for upwards of 200 days.' The reviewer questions whether the volcano has been forcefully active from great depths for that many minutes. There have been eight or nine considerable eruptions, and probably none of these lasted more than five or ten minutes. There is no probability of a void in the interior; there is a fissure system, and with the removal of material from the walls, there is probably collapse that is compensated so gradually by subsidence over a wide area, that it makes no appreciable effect even on the height of shore lines.

As a whole the book is a good exposition in popular style of the main facts connected with the Caribbean eruptions of 1902. There are not sufficient maps to make all geographical matters clear, and there is a lack of diagrammatic illustration, much needed to make intelligible certain explanatory or theoretical statements. The scientific results of Professor Heilprin's research would be more easily grasped if they were tabulated; he will doubtless compile tables in more technical forms of publication. His summary of the phenomena, and the description of events in August which came under his immediate observation, will stand as records of permanent value to vulcanology.

T. A. J., JR.

SCIENTIFIC JOURNALS AND ARTICLES.

THE opening (January) number of Volume 4 of the *Transactions* of the American Mathematical Society contains the following papers: 'Orthocentric properties of the plane *n*-line,' by Frank Morley; 'Definitions of a field by independent postulates,' by L. E. Dickson; 'Definitions of a linear associative algebra by independent postulates,' by L. E. Dickson; 'Two definitions of a commutative group by sets of independent postulates,' by E. V. Huntington; 'Definitions of a field (Körper) by sets of independent postulates,' by E. V. Huntington; 'On the invariants of differential forms of degree higher than two,' by C. N. Haskins; 'Über die Reducibilität der Gruppen linearer homogener Substitutionen,' by Alfred Loewy; 'The quartic curve as related to conics,' by A. B. Coble; 'The cogredient and digredient theories of multiple binary forms,' by Edward Kasner; 'On the envelopes of the axes of a system of conics passing through three points,' by R. E. Allardice; 'A Jordan curve of positive area,' by W. F. Osgood.

THE December number of the *Bulletin* of the American Mathematical Society contains: 'Concerning the commutator subgroups of groups whose orders are powers of primes,' by W. B. Fite; 'Note on irregular determinants,' by L. I. Hewes; 'Note on the projec-

tions of the absolute acceleration in relative motion,' by G. O. James; 'Infinitesimal deformation of the skew helicoid,' by L. P. Eisenhart; 'On integrability by quadratures,' by Saul Epsteen; 'The centenary of the birth of Abel,' by E. B. Wilson; 'The English and French translation of Hilbert's Grundlagen der Geometrie,' by E. R. Hedrick; 'Dickson's linear groups,' by G. A. Miller; 'Buckingham's Thermodynamics,' by E. H. Hall; 'Notes'; 'New publications.' The January *Bulletin* contains: 'The October meeting of the American Mathematical Society,' by F. N. Cole; 'Series whose product is absolutely convergent,' by Florian Cajori; 'Three sets of generational relations defining the abstract group of order 504,' by L. E. Dickson; 'Generational relations defining the abstract simple group of order 660,' by L. E. Dickson; 'The Carlsbad meeting of the Deutsche Mathematiker-Vereinigung, September, 1902,' by C. M. Mason; 'Shorter notices'; 'Notes'; 'New publications.' The February *Bulletin* contains: 'On the transformation of the boundary in the case of conformal mapping,' by W. F. Osgood; 'On the quintic scroll having three double conics,' by Virgil Snyder; 'Surfaces referred to their lines of length zero,' by L. P. Eisenhart; 'Supplementary note on the calculus of variations,' by E. R. Hedrick; 'The synthetic treatment of conics at the present time,' by E. B. Wilson; 'Brown's lunar theory,' by F. R. Moulton; 'The doctrine of infinity,' by E. R. Hedrick; 'Some recent German text-books in geometry,' by P. F. Smith; 'Notes'; 'New publications.'

Bird Lore for January–February has an illustrated paper on 'The Mound-building Birds of Australia,' by A. J. Campbell; an article on 'Making Bird Friends,' by Laurence J. Webster, and one on 'The Return of the Nuthatch,' by E. M. Mead; the 'Christmas Bird Census,' taken in various parts of the United States, and a second series of portraits of members of *Bird Lore's* Advisory Council. The article on 'How to Study Birds,' by Frank M. Chapman, treats of 'The Nesting Season,' and Abbott M. Thayer protests against the use of 'Mounted Birds in Illustration,' a subject which has another side to it, shown in the editor's reply.

The American Museum Journal for February contains a few announcements of material received in various departments, and illustrations of the new ptarmigan groups. The important part of the number is the supplement, by William Beutenmiller, devoted to 'The Hawk-moths of the Vicinity of New York.' Besides a key and descriptions there is an illustration of each species, so that the merest tyro should be able, with the aid of this little hand-book, to identify all. This makes the tenth of the valuable 'Guide Leaflets' issued by the American Museum.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 367th meeting was held Saturday, February 21.

D. E. Salmon spoke of 'The Recent Outbreak of the Foot-and-Mouth Disease in New England.' He said that the effects of an outbreak of this kind, if not promptly checked, would be so disastrous financially that the Bureau of Animal Industry was always careful to ascertain that the malady reported was really foot-and-mouth disease; having ascertained the facts in the present case, every means was promptly taken to stamp it out. Dr. Salmon described the symptoms of the disease, saying that it was so extremely contagious, that it was readily carried from barn to barn by men, dogs and even pigeons, and once introduced into a herd, every member was pretty sure to be afflicted. While the distemper did not, in very many cases, cause death, it was extremely painful to the cattle afflicted, destroyed their value as beef for many months, and dried up the milk at once. Foreign governments prohibited the importation of cattle from afflicted districts, and as the United States exported annually 400,000 cattle and 100,000 sheep, the immediate effect of an outbreak in our western cattle regions could readily be seen. Furthermore, if there were no cattle for exportation some steamship lines would be compelled to withdraw their vessels. The only practical way to check the

disease was to kill the cattle affected, and in New England something like 2,500 head had been killed and their owners reimbursed by the government. The speaker described the methods adopted to kill the cattle and disinfect the barns, and the great precaution taken by the inspectors not to spread the plague.

H. J. Webber discussed 'Egyptian Cotton in the United States,' saying that as this variety possessed many special advantages, we imported annually $10,000,000 worth. Experiments had been made with a view to raising this cotton in the United States, but at first sufficient care was not taken to ascertain the best soil and climatic conditions. In some localities where the plant grew well, it grew too rankly and furnished but little cotton. The speaker then described the methods adopted by the Bureau of Plant Industry to produce plants adapted to conditions found here, and said that the outlook was very promising. Mr. Webber illustrated his remarks by many samples of various grades of cotton and by photographs.

W. E. Safford gave an account of 'The Fauna of the Island of Guam,' describing in some detail the few mammals and the principal birds, fishes and insects.

F. A. LUCAS.

THE CHEMICAL SOCIETY OF WASHINGTON.

AT a special meeting of the Society on February 5, Dr. M. Gomberg read a paper on 'Tri-ethyl-methyl.' The speaker gave a historical review of the work already published, and also of some work which is soon to appear in print. The subjects taken up were: (1) The preparation and constitution of triphenylmethyl peroxide. (2) The preparation of the triphenylmethyl, and also of its ether and ester derivations, the constitution of which is explained on the assumption of tetravalent oxygen. (3) The preparation and the reactions of tripheryliodomethane. (4) The salt-like character of the triphenylhalogen methanes from the chemical, and from the physico-chemical standpoint. (5) The condensation of triphenylmethyl to hexaphenylethane by means of different reagents. (6) Experimental evidence that metals split off only halogen from triphenylchlormethane. Apparatus and specimens of the various preparations were exhibited.

J. S. BURD,
Secretary.

U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

THE TORREY BOTANICAL CLUB.

THE club held its regular meeting on January 28, at the New York Botanical Garden. In the absence of president and vice-presidents Dr. Britton was called to the chair.

The leading paper was by Mr. R. S. Williams, on 'Some Economic Plants of Bolivia.' He mentioned the great diversity of climatic conditions in Bolivia, and stated that at the higher altitudes frosts occur during ten months of the year. Pasture grasses abound at these elevations. Among the chief crops for the higher agricultural lands are barley, wheat, potatoes and quinoa—the edible seed of a species of the Chenopodiaceæ. Many varieties of corn are cultivated up to an altitude of 5,000 to 6,000 feet, and beans of many kinds are also grown. Rice is the principal grain crop of the lower tropical regions. Sugar-cane grows up to 4,000 feet, and there are large fields of it everywhere. It is crushed by passing the stalks back and forth between rollers turned by oxen. The fruits of the lower country are lemons, oranges, bananas, papayas, cherrimoyas, granadillos and a number of others. A species of sorrel, *Oxalis tuberosa,* is largely cultivated. The tubers are eaten as a vegetable. Tomatoes are raised, but they are poor and small. Peppers are in great variety and are much used. Coffee is grown up to 5,000 feet elevation. A fine quality is produced, but distance from the seaboard prevents its export. There are no wild fruits or nuts of value in the regions visited.

The paper was discussed by Dr. Britton, Professor Selby and others.

Mr. F. S. Earle spoke briefly on 'The Fungus Flora of Jamaica.' Jamaican fungi have been mentioned by various writers, beginning with Patrick Browne in 1755, but the total number of species so far reported from the island is less than one hundred. About five hundred members of fungi were collected

by the speaker during his recent visit to Jamaica. The collection has not as yet been sufficiently studied to estimate the number of species represented in it. Nearly half of the entire number belong to the Polyporaceæ, about a hundred to the Agaricaceæ, thirty to the Thelephoraceæ, but only three to the Hydnaceæ. Of the Ascomycetes fully half belong to the Xylariaceæ.

As a rule, fungi are more abundant at the lower elevations and on the drier parts of the island. In the moist mountain woods, where the conditions are most favorable to the growth of ferns, fungi are comparatively rare.

Mr. Nash exhibited a living flowering specimen of an undescribed species of *Pitcairnia* collected by Dr. Britton on St. Kitts, West Indies. Among its more prominent characters are the absence of spines and the conspicuous whitening of the under side of the leaves. Dr. Britton described the finding of this plant at the summit of Mt. Misery on the rim of an extinct crater. It was growing in a deep carpet of moss and was associated with other bromeliads, including *Pitcairnia alata,* which is a spiny species, and an undescribed *Tillandsia.*

Dr. Howe was called to the chair and Dr. Britton presented resolutions on the recent death of Dr. Timothy F. Allen.

MEETING OF FEBRUARY 10.

In the absence of the president, Dr. Lighthipe was called to the chair.

The paper of the evening was by Mr. Eugene Smith, entitled 'Remarks on Aquatic Plants.' The speaker exhibited a series of specimens of marsh and aquatic plants. The distinction between the two is not sharply drawn, but true aquatics pass their entire life under water or at most only produce their flowers and fruit at the surface. The flowers of true aquatics are never showy. Marsh and aquatic vegetation contains elements that are very diverse from a systematic point of view, including representatives from the lowest to the highest families of plants. The algæ are exclusively aquatic and constitute the greater part of the under-water vegetation. The bryophytes are represented by numerous species, a few of which are true aquatics. The pteridophytes have a few aquatic and semi-aquatic members. Many families of flowering plants include aquatic species. With water plants having both submerged and floating leaves there is usually a marked difference in form between the two. The tissues of aquatics are usually soft and flaccid, since these plants, being supported by the water, do not need to develop woody tissues. The study of aquatic plants has been much neglected. The waters of tropical regions in particular afford almost a new field for exploration and study.

An interesting discussion followed the reading of the paper, many of the members present taking part in it.

F. S. Earle,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

THE ST. LOUIS MEETING.

To the Editor of Science: Your recent editorial on the importance of beginning early to make plans for the St. Louis meeting of the American Association for the Advancement of Science and the affiliated scientific societies prompts me to make a few suggestions and to raise one or two questions.

As to the accommodations necessary for a comfortable and therefore profitable sectional meeting there should be for each section of the association: (*a*) a meeting room, (*b*) a lobby or conversation room, and, if possible, (*c*) a coat and toilet room; the three rooms to be close together. It is evident, enough from our experience at various meetings, either that these three elements of comfort are not considered essential by the local committees, or that if they are so considered they can not be secured for all the sections; yet it may be fairly contended that meetings as important as are the gatherings of the sections deserve the reasonably comfortable accommodations above suggested. Further specifications may be made as follows:

Meeting Room.—The table for the presiding officer and the secretary, the platform, blackboard, etc., for the speaker, and the seats for the audience should form a triangle. This arrangement makes it possible for the

occupants of each corner of the triangle to see those of both the other corners. Any other arrangement is likely to involve the presiding officer in much difficulty if he attempts to see the illustrations shown by the speaker, and to impose upon the speaker the discourtesy of turning his back upon the presiding officer. The presiding officer and the secretary should have an open pathway from their table to a neighboring door; a page ready to attend these officers and familiar with the locality of the meeting should be furnished by the local committee. A platform for the speaker, raised somewhat above the floor, should be provided in rooms not thus furnished. Blackboard and pointer, racks, clips and thumbtacks, lantern and screen should of course be in readiness (perhaps some sections may not need the lantern), though it not infrequently happens that some of these necessary luxuries are wanting at the last minute. The auditors should enter by a door or doors at or near the back of the room; and they should not have bright windows in front of them. The room should be large enough to prevent crowding. One might think that ventilation would be arranged beforehand as a matter of course; yet it is a common experience to have to resort to the windows after the meeting room has become suffocatingly uncomfortable, no one being charged with the duty of supplying fresh air; and the windows usually refuse to open at the top, there evidently having been no preparation for so unexpected a use of the upper sash. The air in the sectional meeting room that I frequented this winter in Washington was almost continuously so bad as to be injurious to health. Electric ventilators are of much service in this connection; they can usually be installed temporarily at moderate expense.

Lobby and Coat Rooms.—Emphasis is always and properly laid on the opportunity that the association meetings furnish for renewing and extending one's acquaintance with his associates. This is so important a matter that formal provision should always be made for it. A single room is, therefore, not enough for a good sectional meeting; there should always be a separate lobby or conversation room, near enough the meeting room to be immediately accessible from it, yet not so near that lively conversation in the lobby shall annoy either the speaker or the auditors in the meeting room. Two or three seats at a writing table should be provided here. Now that meetings are to be in the winter, a coat room will be a great convenience, to say the least.

It is very likely that many local committees will find it difficult to provide the three desired rooms for each section; and this elaborate provision will often be impossible if various scientific societies hold meetings at the same time and place with, but independent of, the sectional meetings. The question then arises: Is it worth while to endure continuously uncomfortable conditions of sectional meetings in order to secure the intermittent advantages of occasional general sessions? My own feeling is that a really well-managed meeting of a national scientific society, such as the Geological Society of America, held independent of the association, gives more profit and pleasure to the attending members than they are likely to secure when their meeting is held in conjunction with that of the association. In the latter case it is almost impossible to provide the accommodations that a national society really deserves, and the discomforts of insufficient accommodations seem to me to outweigh whatever advantages come from a general scientific gathering. In short, if the alternative were presented to one of the national scientific societies of being limited to one meeting room when combining with the association, and of having separate meeting and conversation rooms when acting independently, I should vote for the latter, so high a value do I place on the informal part of a scientific gathering. But if really good accommodations can be provided for the sections and the national societies when all meet together, then let us gather in force and secure whatever results may follow from meetings of large enrollment.

There are certain other suggestions that might be presented to the local committees.

Free lunches are a burden on the local committee that no visiting member should wish to impose; scattered lunches interfere greatly with the sociability of the meeting; distant lunches take up too much time. A light table d'hôte lunch should, therefore, be provided at a moderate price in a good-sized and well-ventilated room near the place of meeting, every day while the sessions last. Separate small lunch tables are preferable to a single long table; service is much simplified by having the dishes on a table at one end of the room, where each member may quickly help himself and then withdraw to enjoy the lunch with a group of friends. The less the formality and the greater the freedom of movement, the better for the real enjoyment of the noon hour.

Formal dinners, such as the affiliated societies not infrequently hold and at which one has to sit in one place for three or four hours, are likely to be tiresome to one's neighbors. Informal smokers, with a light supper served from a side table and plenty of little tables at which groups may easily form and break up, afford much better opportunity for meeting and chatting with old and new friends. Besides, the dinners seem necessarily to involve the conventionality of after-dinner speaking, in which one is in danger of grieving his friends with wide-of-the-mark efforts at humor. The smokers are not yet habitually given over to that form of festivity.

Finally, a few remarks as to general sessions. Most of them are tedious. There seems to be a supposed necessity that the association shall be welcomed by some representative local authority, and that some officer shall respond to this address in a preliminary general session; but it would be interesting to try the experiment of meeting once without these formalities, in order to see if science were any the less advanced thereby. This unconventional plan would at any rate have the advantage of allowing the council to arrange three or four, instead of only two, periods in which the vice-presidential addresses could be distributed, thus making it possible for them to be heard by a much larger number of members than is now the case; and this is certainly desirable, for many of the addresses are of broad interest and should attract large audiences. As to the brief general sessions every morning of convocation week, they are often very thinly attended; it must be but a small pleasure to the president and the secretary of the association to officiate at these listless gatherings. Indeed the sectional lists of papers are now so long that time can ill be spared for daily general sessions. The announcements that have been customarily made at the general sessions—for example, the hour and place of an excursion, or the names of new members—can be much more effectively made at the sectional meetings or in the daily programs. The final general session, at which the officers for the ensuing year and the place of the next meeting are voted upon or announced (whichever practice may now be followed) and in which cut-and-dried votes of thanks are passed in perfunctory fashion, have become lifeless affairs, thanks to the efficient work of the council. Few members would be afflicted if even this final general session were replaced by printed announcements. The two general sessions in the evening, to hear the retiring president's address and the general scientific lecture, are on the other hand of real value in advancing science, and should be maintained.

The intention of all these suggestions is to make it possible for those who attend the meetings of the association to spend their time most effectively and comfortably. Conventional formalities, bad air and distracting gymnastic efforts at opening windows, insufficient room and time for social intercourse are unnecessary hindrances to the best enjoyment of convocation week; and there is no sufficient reason why many or all of these hindrances should not be removed.

W. M. Davis.

Cambridge, Mass.,
February 25, 1903.

THE POLICY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

I have attended many meetings of the American Association for the Advancement of Science and have watched with great interest the progress that has been made—espe-

cially during the past three years. An able standing committee looks after its policy, and notwithstanding the large increase of members, this policy is to advise reducing the size and value of the proceedings by printing only the addresses of the president and vice-presidents, with list of officers and members and a few other items, to the end that more money may be accumulated, that it will earn more interest and enable the society to give a very few persons a small portion of the cost of engaging in some research.

Not many months ago SCIENCE contained a large number of interesting communications by way of gentle reminders as to how the trustees of the Carnegie Institution could best use the funds soon to be at their disposal. This was a kind and thoughtful service and no doubt highly appreciated by the trustees. Among these gentle hints was named the pressing need of means for publishing worthy articles such as might not be published by any of the numerous journals or might not find a place in the proceedings of any of the learned societies.

When the *American Naturalist* was established in 1868, I am sure the editors were not troubled to find room for all worthy articles in the entire field of botany and zoology, including some that bordered on geography and geology. Workers in these broad fields were comparatively few and far between. In these days, universities and colleges have established many courses attracting a large increase in students, requiring numbers of teachers, some of whom devote a portion of their time to original work. The U. S. Department of Agriculture employs many; the state experiment stations many; bureaus of geology, ethnology, and meteorology and others are growing rapidly.

I dare not attempt to name the journals and transactions that are issued from time to time.

It is getting to be the plan for most universities to publish each from one to four or more periodicals devoted to as many special departments of learning, soon to find that the members of the faculty, their fellows and advanced students, without any outside help, write enough papers or nearly enough to fill all the pages of these journals.

The programs of the meetings of the American Association are filled with valuable papers, at least if they are not valuable it is the fault of the committees whose duty it is to inspect the list before reading.

One of the reasons sometimes advanced for omitting to print these papers in the *Proceedings* of the association is that any papers that are worthy will be sought by the editors of some scientific journals. We have now reached a period when this is far from true. The value of a paper can not be measured by its popularity.

At the meetings of the American Association we hear papers read and we are interested in them—some we can not hear, owing to numerous conflicts of programs. For myself I make a memorandum of those I hope some day to be able to read, but by some hook or crook I seldom get them.

In days past I have often looked in the *Proceedings* for some article important to me, to find an abstract of a few lines only, or rarely a reference to some publication where it has been printed.

I feel confident that if we had a full canvass, a large majority of the members would be glad to see these papers printed in the proceedings of the American Association. For printing papers, it is true we have SCIENCE, a magnificent publication, but we see even in this there is not room for all.

Every few months our attention is called to some new means of support for worthy investigators—and liberal support. I need not enumerate them. The fees that the American Association is able to pay for research are very trifling. Why not use all the funds that henceforth accumulate, up to a certain specified amount, to defray the expenses of printing and *illustrating* first-class reports? What better use could be made of the money?

If I am not mistaken, one reason for organizing some of the 'affiliated' societies was that the members could publish the papers read at their meetings. I have known a number of instances in which itinerant societies for worthy purposes have economized to save a

fund, the interest of which might serve the means of partial support, but through some oversight a large portion of the original fund was dissipated. I think our fund is as large as it should be, perhaps larger. I shall be surprised if some of the conservative and substantial fellows and members of the American Association for the Advancement of Science do not come out in support of the views here expressed. W. J. Beal.

Agricultural College, Mich.,
February 20, 1903.

ABUNDANT HONORARY DEGREES.

To the Editor of Science: In *Bulletin* No. 12, Volume III., issued by the University of Missouri, is a review of the manifold achievements of the university, especially those of benefit to the state of Missouri.

Along with other items appears the statement that 2,869 degrees have been conferred 'for work done.' 'Of honorary degrees 152 have been conferred.' Figured into percentage the number of honorary degrees becomes nearly 5.3 per cent., or more than one honorary degree for every twenty regular degrees. I think Missouri is to be congratulated upon the extraordinary proportion of eminent men connected with her university, and I can not help wondering why I am so ignorant as never to have heard of the names even of many of those of the honorary 5.3 per cent. class. I wonder less, perhaps, than might be expected because the custom of bestowing honorary degrees on unknown people is almost universal among American colleges and universities.

Is it not time to raise a universal protest against this habitual debasement of the highest academic honor? All of our universities sin grievously in this respect, and give honorary degrees to soldiers, politicians and many other classes of worthy people who can not present the slightest claim to scholarly eminence.

When we consider how much more many a little-known scholar does for the world than many celebrated soldiers and politicians, it seems proper that the practice should be reversed. I venture, therefore, to propose: (1) That we all strive to restrict the bestowal of honorary degrees exclusively to scholars and investigators, who alone have any claim to them, and (2) that we petition the national government to make all eminent physicists honorary generals, all eminent chemists honorary admirals, all eminent naturalists honorary governors, and all members of the National Academy honorary senators.

C. S. M.

Boston, February 23, 1903.

SHORTER ARTICLES.

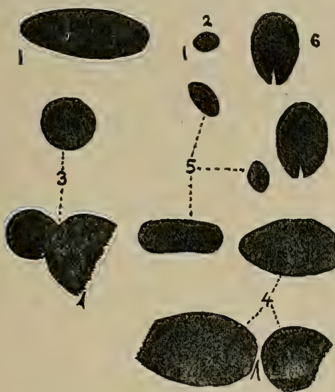
THE SACRAL SPOT IN MAYA INDIANS.

In 1901, while at Tekax, Yucatan, making measurement of the Mayas of that district, the parish priest told me that it was commonly believed that every pure-blood Maya Indian had a blue or purple spot upon his back, in the sacral region. He said that this spot was called *uits*, 'bread,' and that it was an insult to a Maya to make reference to his *uits*. To satisfy the curiosity of the priest, and my own, I examined a boy of ten years and two men, all of pure Maya blood. No one of the three presented any trace of a sacral spot, and I concluded that the common belief, if it had any basis, must relate to an infantile spot such as has long been known to occur in the Japanese, Eskimo, etc. Having no opportunity then to examine Maya babies, I determined to watch for the sacral spot among the infants of such tribes as I might later visit.

In my last journey to Mexico, just ended, I expected to see babies among six Indian populations—Aztecs, Zapotecs, Tzotzils, Tzendals, Chols and Mayas. From changes in my plan I really came into contact with the Aztecs and Mayas only. Aztec friends in whom I have confidence, in the states of Pueblo, Mexico and Tlaxcala, agreed that Aztec babies do *not* have a sacral spot; I made no personal examination.

In the town of Palenque, Chiapas, I examined all the *little* babies of the town—not a heavy labor, as the town is small. The people here call themselves Mayas, but claim to be closely related to the Chols. Probably the population is a mixture of the two peoples, who are closely related in language, and

probably in blood. To my surprise, I found the spot in every one of the seven babies of pure Indian blood. It seems, however, to be far more evanescent among the Mayas than among the Japanese and other populations, being rarely found in individuals of more than ten months of age. Three babies, less than ten months in age, but of mestizo (mixed-blood) parentage, showed no trace of the spot. The spot is variable in size, shape and position, but it is always in the sacral region; in color it is blue or a bluish-purple; it gradually disappears and two or three of the cases seem to show an original single spot broken up into separate blotches which lose distinctness.



The sizes and shapes of the spots observed are accurately shown in the accompanying cut, reduced to one half the diameter. The notes made regarding each are here presented:

1. Boy; eight months. Spot well marked; dark purple; median, three inches above the anal fold. An older brother, two years old, showed no sign of the spot, but his mother says he was equally well marked at birth.

2. Girl; one year. Spot well defined; just to the right of the upper end of the fold.

3. Girl; three months. Two faint and badly defined spots just to the left of the upper end of the anal fold; a darker and better defined spot above.

4. Boy; two months. Two faint and badly defined spots, one on either side of the anal fold; a third, darker and better defined, above.

5. Boy; ten months. Only the lower of three spots is fairly defined, and it is faint, like a disappearing bruise; the other two are fainter. The three look like the separated parts of a spot which is disappearing. The group is median and located a little above the anal fold.

6, 7. Boys; twins of two months. Spots are pale blue but well defined; they are almost identical in form, size, color and position. They just overlap the upper end of the anal fold. FREDERICK STARR.

February 6, 1903.

THE EGGS OF THE EASTERN ATLANTIC HAG-FISH, MYXINE LIMOSA *Gir.*

EGGS of a hag-fish from the Newfoundland banks were described by the present writer in 1900 (*Mem. N. Y. Acad. Sci.,* Vol. II., pp. 31–43) from specimens in the Verrill collection, Yale University. They were then looked upon as belonging to the common North Atlantic *Myxine glutinosa* Linn. Since that time, however, the eggs of five other species of myxinoids have been examined, and a fairly definite knowledge is at hand in the matter of the degree of variation in these eggs within specific limits. It follows from these studies that the differences between the eggs of *M. glutinosa* as described by Jensen and those of the Newfoundland form are too great (*op. cit.,* pp. 35, 42) to warrant the eggs of both types to be included under *Myxine glutinosa.* Accordingly I have come to the conclusion that we must consider the American specimens as probably representing *Myxine limosa* Girard, the common hag-fish of Maine. I would also note that a study of variation among myxinoids has recently led me to conclude with Mr. Garman that *Myxine limosa* is to be accepted, not as a variety of *M. glutinosa,* but as a valid species.

BASHFORD DEAN.

ORIGIN OF NAME MONOTREMES.

I HAVE been unable to find any reference to the early use of the now familiar name Monotremes, and the information may be of

use to some of your readers. I, therefore, give exact reference.

At the session in 'Thermidor, an 11 de la Republique' (1803), 'E. Geoffroy' [Saint Hillaire] presented an 'Extrait des observations anatomiques de M. Home, sur l'echidné,' which was published in the *Bulletin des Sciences de la Société Philomathique* (Tome III., p. 225–227—misprinted 125–127—pl. 14–16). In this communication Geoffroy remarks that '*Ornithorhincus*' (*Ornithorhynchus*) and *Echidna*, though closely related, are generically distinct, but should be united in the same order ('*ordre*'). He reasons as follows:

"Mais, cependant, comme il est démontré, par la dissertation de M. Home, que ces deux genres s'appartiennent par un assez grand nombre de rapports, je les réunis dans le même ordre, sous le nom MONOTRÉMES, avec le caractère indicateur suivant: *Doigts onguiculés; point de véritables dents; un cloaque commun, versant à l'extérieur par une seule issue.*"

In this article was also published the name *Echidna setosa*, as is well known.

Rafinesque, in 1815, in the 'Analyse de la Nature' (p. 57), gave the Latin form Monotremia to the word, adopting it for his '16 famille' of mammals.

THEO. GILL.

COSMOS CLUB.

CURRENT NOTES ON PHYSIOGRAPHY.

OVERTHRUST MOUNTAINS OF NORTHERN MONTANA.

THE physiographic features that are associated with various stages of dissection of uplifted, folded or faulted structures are coming to be fairly well known; but the features resulting from the dissection of overthrust masses have as yet hardly gained recognition in systematic physiography. Hence the importance that attaches to certain passages in an account by Willis of the 'Stratigraphy and Structure, Lewis and Livingston ranges, Montana' (*Bull. Geol. Soc. Amer.*, XIII., 1902, 305–352), where a great overthrust has carried a heavy and resistant series of nearly horizontal Algonkian strata more than seven miles eastward over the previously warped Cretaceous strata of the plains. The overthrust mass is now greatly denuded; castellated outliers and promontories stand forward between large embayments, and the embayments are drained eastward over the plains as if the original drainage of the overthrust mass (presumably westward) had been destroyed by the retrogression of the overthrust escarpment. Before the overthrust took place, the relatively weak strata of the plains had been worn down to a peneplain; and it is believed that the Algonkian strata further west had at the same time been reduced to moderate relief. The general uplift associated with the overthrust exposed the plains to dissection, but remnants of their peneplain phase are still well preserved. The more active uplift of the overthrust raised the Algonkian strata to mountain height and allowed their deep dissection, but back of the Front ranges the subdued forms of the earlier cycle are still more or less preserved in the mountainous uplands at heights of 7,500 feet, where the general profile is independent of structure. In the front ranges, where the mountains rise to heights of 9,000 and 10,000 feet, revived erosion, by both water and ice, has caused so great a dissection that no trace is to be seen of whatever subdued forms may have existed before uplift. Here the very general association of the higher summits with anticlinal belts, and of the intermediate longitudinal valley with a shallow synclinal belt, suggests corrugation at as late a date as that of the overthrust by which the general uplift was produced. Strong erosion by heavy valley glaciers is inferred in the Front ranges, where high-cliffed amphitheatres holding lake basins are characteristic features. One of the most notable peculiarities of the district is the location of the continental divide at the eastern base of the mountains, where a branch of Flathead river (Columbia system) rises at the very margin of the plains in the pass that is followed by the Great Northern Railroad.

THE OASES OF SOUF AND M'ZAB.

THE dual character of geography is seldom better represented than in a study by Brunhes on 'Les oasis du Souf et du M'zab comme types d'établissements humains' (*La Géogr.*, V., 1902, 5–20, 175–195); that is, the physiographic environment and the organic response

both receive adequate attention. The oases of Souf are in a region of dunes, the 'erg' of the Algerian Sahara, separated from other settlements by several days' journey; everything here depends on removing the sand until the surface is lowered near enough the groundwater to enable date palms to grow; the heaped-up sand-ridges are as high as the tree tops, and as the wind blows the sand freely, continual labor is necessary to keep the gardens free from drifts. Yet under these highly adverse conditions, the oases contained in 1899 an industrious population of 22,620 souls, owning 6,979 camels, 24,510 sheep, 27,864 goats, and 192,152 palm trees. The Soafas have become expert trailers, for nothing can cross the sands without leaving a track. Theft is, therefore, less common here than elsewhere in the desert, for the thief can be so easily followed and discovered that thieving does not pay.

The oases of M'zab are in the stony desert or 'hammada' of a calcareous plateau. Here wells are dug in the valleys, and water is raised day and night for irrigation; rain is stored in reservoirs and led about in canals. The gardens have a luxurious vegetation; dates, figs and other fruits are produced. The population of seven M'zab towns in 1896 was 25,254 souls, owning 490 camels, 5,732 sheep, 3,837 goats, and 166,261 palms; besides these there are 5,795 semi-nomads with a much larger property in live stock. A fine palm is worth $100 or more; many of the Mozabites are rich. From both of these crowded populations emigrants go out northward to less arid lands. For both groups of oases Brunhes emphasizes an important fact: the people are not savages supplying their simple wants in a rudimentary manner; they are in an advanced stage of culture, their arts are highly elaborated, and are wonderfully adapted to making the best use of unfavorable surroundings, and their caravans maintain an active trade across the desert.

THE OTHER HALF OF GEOGRAPHY.

IF geography be concerned with the relation of the earth and its inhabitants, and if physiography be taken as the study of the physical environment of life, or the inorganic half of the total subject, it is apparent that there is no convenient name for the other half, in which the response of the inhabitants to their environment is considered. It is also true that there is to-day no well-organized and systematic treatment of the other half, although partial treatments abound, especially of the human elements of the subject, as in the works of Ratzel. There is good reason for thinking that the progress of geography in the century now opening will remedy these deficiencies; that the organic responses appropriate to many kinds of environments will be carefully collected and classified; that the attention of the geographical observer will be equally directed to both halves of his subject; and that geography will be greatly benefited thereby.

The preceding note gives a good example of a curious response to a desert environment, reaching even the moral sense. The rapid development of the study of physiography in our national surveys of the western semi-arid region, where the relation of structure and form is laid bare, exhibits a response of an intellectual kind to a climatic environment. Lugeon has suggested that it is not —as some have thought—an inherent spirit of independence in the Swiss that prompts them to maintain separate organizations in the minute village communities of the Alpine valleys, but that the physiographic opportunity for village settlements requires the development of many small communities instead of a few larger ones, and thus aids in the development of the spirit of independence. Fewkes has given an admirable example of the response of religion to environment in the 'Tusuyan ritual' (*Smithsonian Rep.*, 1895, 683–700). The systematic exploration and analysis of this phase of geography deserves much more attention than it has yet received. A fuller consideration of this aspect of the subject is given in two essays by the undersigned: 'Systematic Geography' (*Proc. Amer. Phil. Soc.*, XLI., 1902, 235–257) and 'The Progress of Geography in the Schools' (*Nat. Soc. Sci. Study Education*, I., Pt. II., 1902, 7–49).

W. M. DAVIS.

THE D. O. MILLS ASTRONOMICAL EXPEDITION.

The D. O. Mills Astronomical Expedition from the Lick Observatory, University of California, sailed from San Francisco on February 28, to Valparaiso, Chili. The purpose of the expedition is to measure spectroscopically the line-of-sight velocities of the naked-eye stars in the Southern Hemisphere which are not visible at Mt. Hamilton. The observing station will be in the vicinity of Santiago, either on one of the low hills in the suburbs of the city, or along the line of the railway running from Santiago to Valparaiso. The apparatus consists principally of a 37¼-inch reflecting telescope, Cassegrain form, to which is attached a powerful three-prism spectrograph. The instruments will be covered with a modern 30-foot steel dome. The expedition is in charge of Acting Astronomer William H. Wright, and he will be assisted by Mr. H. K. Palmer. Professor Wright has been a member of the Lick Observatory staff for the past six years, engaged in line-of-sight determinations with the Mills Spectrograph attached to the 36-inch equatorial. Mr. Palmer was for four years a fellow in the Lick Observatory. The government of Chili has taken note of the coming of the expedition, by admitting all the effects duty free, and by volunteering to further the purposes of the expedition in every possible way.

AMERICAN ORNITHOLOGISTS' UNION EXCURSION TO CALIFORNIA.

The American Ornithologists' Union at its last session appointed a committee to consider the question of a spring meeting in California. The committee announces that it finds that the railroads are not only willing to grant very favorable rates, but that most satisfactory arrangements may be made with respect to stop-over privileges. In order that those who go may see as much as possible it is planned to make various stops in New Mexico, Arizona and southern California, including one at the Grand Canyon of the Colorado. It is planned to charter special Pullman cars for the outward journey so that the party may travel comfortably and as a unit, and to spend about ten days between Chicago and San Francisco. The plan is to leave Chicago May 3, to reach San Francisco on or about May 13, and to hold the special meeting May 15–16 in conjunction with the California members of the American Ornithologists' Union and the members of the Cooper Ornithological Club. The cost of the round trip is a single fare from the starting point to Chicago plus $50, and the tickets are good to July 15. Members of the union may invite friends interested in science to take part in the excursion. The committee consists of C. Hart Merriam, chairman; T. S. Palmer, and John H. Sage, secretary of the union, to whom communications should be addressed at Portland, Conn.

MINUTE IN REFERENCE TO THE DEATH OF PROFESSOR WILLIAM HARKNESS, U.S.N.

At a meeting of the staff of the Naval Observatory and Nautical Almanac Office, held March 2, 1903, Captain C. M. Chester, Superintendent of the Naval Observatory, read the sad announcement of the death of Professor William Harkness, U.S.N., at Jersey City, N. J., at 3:37 P.M., February 28, 1903. Through a committee appointed at this meeting, the staff of the Naval Observatory and Nautical Almanac Office expresses its deep regret at the death of their colleague, and extends its heartfelt sympathy to his relatives in their bereavement.

Throughout all his connection with the Observatory, for 37 years previous to his retirement in 1899, a conscientious faithfulness even to the minutest details characterized the performance of all his duties. This adherence to duty was so rigidly carried out by him that he rarely gave himself the occasional relaxation so necessary to the recuperation of wearied energies, which might have added years of usefulness to his life.

The fruits of his laborious life as aid, professor of mathematics, U. S. Navy astronomical director of the observatory and director of the Nautical Almanac Office, are shown by voluminous scientific papers, whose publication has not been limited to the volumes

issued by the Observatory and the Nautical Almanac Office.

A large part of his energies was devoted through many years to service as a member of the Transit of Venus Commission.

During the past year it has been a special cause of regret to him that feebleness of body should compel him to forego participation in scientific work; meanwhile continually hoping soon to recover strength sufficiently to permit his return to Washington to complete various pieces of scientific work.

His energy and faithfulness should be emulated by all. His example should spur us on to greater faithfulness, activity and zeal in carrying on labors commenced by him and providentially committed to us to continue.

By unanimous vote it was resolved that the superintendent of the Naval Observatory be requested to place the above tribute to the memory of the late Professor William Harkness on the records of the Observatory, and to transmit a copy to the members of his family.

The foregoing minute having been read Mr. Thomas Harrison, the oldest associate of Professor Harkness at the observatory, made the following remarks, which by unanimous vote were appended to the minutes:

On this sad occasion, Mr. Chairman, I can not forbear to say a word, though it be only to regret my inability adequately to express the regard I have for many years entertained for the man whose memory we have met to honor.

It would be unbecoming in me to speak of his great and valuable labors at the Naval Observatory, the results of which have done so much to sustain the high reputation in this country and abroad that is now enjoyed by the Institution with which his name has been so long associated. These labors fall appropriately under the notice of those present who were his colaborers in the same field, and who can more readily than myself comprehend their magnitude and their value. But a personal reference may be allowed.

Professor Harkness came to the Observatory during the stirring events of 1862, when in the vigor of early manhood. He was assigned at once to the rank among scientists due to his varied attainments; and his life work then auspiciously begun, continued, ever widening in scope and influence, to the day of his death, which has just been announced.

The fact that I was permitted to enjoy his friendship will always be classed with the happy circumstances of my official life—a friendship which began 41 years ago, and continued to the moment he was stricken by the hand of death.

The often-quoted lines of Horace on the 'Just Man,' may well be applied to William Harkness.

March 2, 1903.

SCIENTIFIC NOTES AND NEWS.

A NOBEL Prize Committee has been organized in Great Britain with Lord Avebury as chairman.

MR. WILLIAM R. MERRIAM has resigned the directorship of the census.

M. LÉON LABBÉ, the surgeon and anatomist, has been elected a member of the Paris Academy of Sciences.

THE University of Glasgow will on April 21 confer the degree of LL.D. on Sir William Tennant Gairdner, emeritus professor of medicine in the University of Glasgow; Sir Norman Lockyer, F.R.S., director of the Solar Physics Observatory, South Kensington; Dr. Thomas Oliver, professor of physiology in the University of Durham and Mr. Philip Watts, F.R.S., director of naval construction, Admiralty, London.

THE University of Edinburgh will confer the LL.D. degree on Dr. Arthur Gambee, emeritus professor of physiology, Owen's College, Manchester; on Sir Norman M'Laurin, M.D., chancellor of the University of Sydney, and on Mr. Benjamin Peach, of the Scottish Geological Survey.

DR. WILLIAM R. BROOKS, director of Smith Observatory and professor of astronomy in Hobart College, has been awarded the Comet medal of the Astronomical Society of the Pacific for the discovery of his twenty-third

comet. This is the seventh award of the medal to Dr. Brooks.

Professor Edward S. Dana, of Yale University, whose ill health during the past three years has compelled him to give up the larger part of his class work, has gone to the Bermudas, where he will remain for several months.

Dr. J. T. Rothrock offered his resignation as commissioner of forestry of Pennsylvania, but later was induced by the governor to recall it.

Otto J. Klotz, astronomer of the Department of the Interior, Canada, leaves shortly for the Pacific, in charge of the longitude determinations along the British Pacific cable. By this work the earth will for the first time be girdled in longitude. The stations occupied will be Vancouver, Fanning, Suva, Norfolk and Southport, near Brisbane, Australia. Connection will also be made with New Zealand from Norfolk, where the cable bifurcates.

Professor L. M. Underwood, of Columbia University, spent part of January and February in Jamaica, studying the ferns of that island; this month he is making similar investigations in Cuba. Dr. N. L. Britton, director of the New York Botanical Garden, is also in Cuba.

The board of governors of the University Club, Philadelphia, tendered a reception and dinner to Dr. S. Weir Mitchell on Friday evening, February 27.

A complimentary dinner will be offered to Sir William White, F.R.S., lately director of naval construction to the British government, on March 26.

A souvenir number of the *Zeitschrift für Ohren-Heilkunde* was presented to Professor F. Bezold, known for his researches on the sense of hearing and its diseases, on the twenty-fifth anniversary of his professional career by his pupils and assistants.

Dr. E. Hitzig, director of the clinic for nervous diseases and the polyclinic at Halle, especially known for his experiments on cerebral localization, has resigned his professional duties on account of a progressive eye effection.

Captain Edward Appleton Haven, of Lynn, who has been selected as first officer of the steamer *America* on the Zeigler polar expedition is about to leave for Norway.

At the last meeting of the Zoological Society of London a motion was passed to the effect that the testimonials of Mr. W. L. Sclater, appointed by the council secretary *ad interim,* and those of Dr. Chalmers-Mitchell, the candidate for whom a minority of the council voted, should be printed and distributed to the fellows.

At the annual meeting of the British Institution of Mechanical Engineers on February 20, Mr. W. H. Maw resigned the chair to the newly elected president, Mr. J. Hartley Wicksteed. 520 new members have joined the institution during the year, and the membership is now nearly four thousand.

The Cambridge Philosophical Society on February 2 passed a resolution in memory of the late Sir George Gabriel Stokes, and adjourned as a mark of respect.

The British Virchow Memorial Committee has received £225 from ninety-seven subscribers.

A memorial tablet has been placed in the Anatomical Institute at Heidelberg to celebrate the hundredth anniversary of the birth of the anatomist, Friedrich Arnold.

The death is announced at Goerz, in Austria, of Ritter Karl von Scherzer, who took a leading part as scientific expert in the voyage of exploration around the world of the Austrian frigate *Novara* in the years 1857–1859.

Mr. Francis Cranmer Penrose, F.R.S., known for his work in astronomy, archeology and architecture, died on February 15 at the age of eighty-five years.

The death is also announced of M. Reboul, dean and honorary professor of chemistry at Marseilles.

The Carnegie Institution has granted the sum of $4,000 to the Lick Observatory for the present year, for the employment of assistants and computers. The director invites applications for these positions from well-equipped persons, especially from those who

are looking forward to an astronomical career.

The College of Physicians of Philadelphia has secured pledges of $50,000 which makes available the $50,000 offered by Mr. Carnegie for a library building. The question has now arisen whether it would be better to enlarge the present building or to erect a new building on a different site.

As we have already stated the Congress of American Physicians and Surgeons will hold its sixth triennial session at Washington on May 12, 13 and 14. Sixteen national societies devoted to the medical sciences, including the American Physiological Society, the Association of American Anatomists and the American Association of Pathologists and Bacteriologists, join in the congress. The president is Dr. William W. Keen, of Philadelphia, who will deliver an address on the evening of May 12. The general sessions of the congress will be held on the afternoon of May 12 and 13.

The Boston *Transcript* says a plan has been definitely approved for the holding of an International Congress of Arts and Sciences at the St. Louis Exposition. The congress is to convene on Monday, September 19, 1904, and continue until Friday, September 30. The congress will have before it the definite task of bringing out the unity of human knowledge, with a view to correlating the scattered theoretical and practical scientific work of our time. The addresses are to be prepared by the greatest authorities in each branch of knowledge. In each of the various subdivisions two papers will be presented—one on the history of that particular department of knowledge during the past one hundred years, and the other on the problems that now present themselves for solution in that field. It is planned to publish the proceedings, which, it is hoped, will be a permanent contribution to the cause of scholarship. An executive committee of representative scholars, Professors Simon Newcomb, of Washington, Hugo Münsterberg, of Harvard University, and Albion W. Small, of the University of Chicago, has been intrusted with the task of elaborating the details of this plan. It is expected that the three members of this committee will spend several months in Europe in the near future, conferring with the leading European scholars with a view to interesting them in the plan and securing their full cooperation.

A committee has been organized for the International Botanical Congress which will meet in Vienna from June 12 to 18 in 1905. The honorary presidents are Professor Edouard Suess, president of the Imperial Academy of Sciences and the Austrian ministers of public instruction and of agriculture. The presidents, elected at the Paris congress of 1900, are Professors de Wettstein and Wiesner, of the University of Vienna. Correspondence in regard to the congress should be addressed to the secretary, Dr. A. Zahlbruckner, Bergring 7, Vienna.

The National Dairy Association of Belgium has decided to hold an international congress at Brussels during the month of September, 1903, immediately after the eleventh Congress of Hygiene and Demography.

The Indiana legislature has passed a bill which has been signed by the governor, the effect of which is to set aside under the control of Indiana University a tract of land of over 200 acres for an experimental farm. The land is covered by primitive forest and lies at the edge of the great cave region of the Ohio valley in which Wyandotte and Mammoth caves are situated. On this land are the only entrances to an extensive underground 'well' or brook which pours out its water into a narrow valley also on this farm. A large room 40 x 230 feet, easily accessible, is within 100 feet of the exit of the river. The farm is said to be ideally adapted for experimental work with cave animals. The land belonged to an alien without naturalized heirs, and on his death escheated to the state of Indiana. His heirs brought suit to recover it and the lower court confirmed the title to the state; an appeal is now pending in the supreme court.

The University of California has leased for two years two square miles in Shasta county, California, where Professor John C. Merriam last summer secured valuable collections of fossils.

The Sharon Biological Observatory, a sum-

mer school for teachers at Sharon, Mass., will experiment in forestry on a tract of 300 acres of woodland, which it purposes making into a model forest. Application has been made to the Bureau of Forestry for a working plan. The director of the school, Dr. Geo. W. Field, is an instructor in the Massachusetts Institute of Technology.

UNIVERSITY AND EDUCATIONAL NEWS.

Barnard College, Columbia University, has received from an anonymous donor about $1,000,000 to purchase the three blocks of land adjoining the college on the south.

The Indiana legislature has passed bills increasing the tax levy for the higher educational institutions. The income of Indiana University will thereby be increased by about $45,000 annually with a proportionately larger increment from the increase in the value of taxable property.

Harvard University will receive ultimately $10,000 for the establishment of a scholarship and $5,000 for the Semitic Museum by the will of Jacob A. Hecht.

The Carnegie Trust of the Scottish universities has made public an announcement in regard to scholarships, fellowships and grants. The value of the scholarships is £100 and of the fellowships £150, the former being given to afford an opportunity in training for research and the latter to those who are competent to undertake independent research. The number to be awarded is not yet determined, depending on the demand. The grants are to be made only to teachers in Scotland or graduates of Scottish universities resident in Scotland. The recipients of grants may publish their work where they see fit, and instruments of permanent value purchased by means of the grant are to be placed at the disposal of the institution in which the research has been conducted.

The Privy Council has recommended the creation of a University of Liverpool and a University of Manchester, and it is expected that the university colleges of Leeds and Sheffield will be united in a university for Yorkshire.

It was announced to the court of governors of the University of South Wales in Monmouthshire on February 19 that the council had recommended that compulsory Latin for the matriculation should not be required of students in applied science.

The Association of Public School Science Masters sent a delegation to Oxford University on October 14 to urge that the examination for entrance scholarships in science at the universities of Oxford and Cambridge be made more uniform. They also recommended the abolition of compulsory Greek.

The government of Nicaragua will send fifteen students annually to colleges of agriculture in the southern states.

Professor E. F. Nichols, of Dartmouth College, has been elected to a chair of physics in Columbia University. At the same university Mr. Charles A. Strong has been promoted to a professorship of psychology and Dr. Livingston Farrand, adjunct professor of psychology, has been made professor of anthropology.

At Barnard College, Columbia University, Dr. H. M. Richards has been promoted to an adjunct professorship of botany, and Miss Margaret E. Maltby to an adjunct professorship of botany.

Dr. Frederick DeForest Heald, now professor of biology in Parsons College, Iowa, has been elected to the position of adjunct professor of plant physiology and general bacteriology in the University of Nebraska. He will assume office during the summer, and will take part in the work of the university summer session, having charge of the classes in botany.

Miss Margaret F. Washburn, assistant professor of psychology and dean of women in the University of Cincinnati, has been appointed associate professor of philosophy in charge of psychology in Vassar College.

Dr. Eugen Oberhummer, associate professor of geography at Munich, has been called to the chair of geography at Vienna, and Dr. Robert Singer has been made associate professor of geography at the same university.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 20, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*SOME RECENT IDEAS ON THE EVOLUTION OF PLANTS.**

THERE is endless dissimilarity in nature. No two plants and no two animals are exactly alike. There are more plants and animals than can find a place in which to live and thrive. There results a struggle for existence. Those animals or plants which, by virtue of their individual differences or peculiarities, are best fitted to the conditions in which they are placed, survive in this struggle for existence. They are 'selected' to live. Those that survive propagate their peculiarities. By virtue of continued variation, and of continual selection along a certain line, the peculiarities may become augmented; finally the gulf of separation from the parental stem becomes great and what we call a new species has originated.

This, in epitome, is the philosophy of Darwin in respect to evolution of organic forms. It contains the well-known postulate of natural selection, the principle that we know as Darwinism. This principle has had more adherents than any other hypothesis of the process of evolution. All recent hypotheses in some way relate to it. A number of them modify it, and some cut across it. The most pronounced counter-

* Address before the Society for Plant Morphology and Physiology, Washington, December 29, 1902.

hypothesis is also the newest. It is that of Professor De Vries, botanist, of Amsterdam, who denies that natural selection is competent to produce species, or that organic ascent is the product of small differences gradually enlarging into great ones. According to De Vries's view, species-characters arise suddenly, or all at once, and they are ordinarily stable from the moment they arise.

I. VARIATION: DE VRIES.

De Vries conceives that variations, or differences, are of two general categories: (1) Variation proper, or small fluctuating, unstable differences peculiar to the individual (only partially transmitted to offspring), and (2) mutations, or differences that are usually of marked character, appear suddenly and without transition to other forms and are at once the starting-points of new races or species. The variations proper may be due to the immediate environment in which the plant lives. The mutations are due to causes yet unknown, although these causes are considered to be physiological.

Natural selection works on both variations and mutations by eliminating the forms that are least adapted to persist. It is conceived to be a destructive, not a constructive or augmentative, agency. It merely weeds out.

We may first consider selection with reference to variations proper. Among variations, or individual fluctuations, there may be a slight cumulative effect of selection, but it is incompetent ever to enlarge the differences into stable characteristics; and when natural selection ceases to act, the so-called variety falls back into its original form or splits up into other forms. Varieties of this kind are notably indefinable and unstable. It is impossible to 'fix' them in any true sense; selection only preserves them, and when it is removed they perish as varieties. They are relatively only temporary and have no effect on phylogeny. Many of the minor adaptations of plants to the particular conditions in which they chance for the time being to be placed are of this category. Much of the variation which results in acclimatization belongs here. The fluctuating horticultural varieties, and gardeners' 'strains,' are of this kind. This discussion of the effect of cessation of selection recalls Weismann's panmixia, a name proposed to designate the breaking up of varietal or specific characteristics when natural selection ceases to act. Panmixia is not of itself an original force or an agency; it is merely a name for the results of all the forces or energies which are allowed to assert themselves when the restricting force of natural selection is removed. In De Vries's view, the progress made by selection must be maintained by selection.

We may next consider selection with reference to mutations. The mutations are practically stable or 'fixed' the moment they arise. Of course there may be individual fluctuations, or variations proper, amongst plants that have sprung from a mutated individual; but the main characteristics of the mutations are heritable. An organism is a complex of organs and attributes. Each attribute is a unit. From any unit a new unit may arise by mutation. The origination of a new unit constitutes at once a full and important character and marks the organism that possesses it as a new physiological species. Not only one unit, but any number of units, may give rise to mutations; and any one of these new mutations may give rise to other mutations. But the point is that these mutations, be they great or small, arise by steps, are full-formed when they arise, and do not grow or enlarge into other mutations. The mutations are multifarious

(*all-seitig*), occurring apparently at random and in diverse directions, and without regard to fitness. They may be either quantitative or qualitative. Variations proper arise mostly in a definite line. Now, natural selection may weed out mutated individuals as it does mere variant individuals; and thus breaks may arise in the chain, and we have left what we know as taxonomic species.

Natural selection, with survival of the fittest, is, therefore, of two distinct categories,—that which operates within the species and results in the formation of local minor races, and that which operates between species and results in the formation of a line of ascent.

Everywhere and always plants are variable. Now and then and relatively rarely, plants are mutative. Any man who sees two plants, sees variation; there are no two plants alike. Only he who studies and observes critically, sees mutation. One must examine a hundred or a thousand or ten thousand individuals. In De Vries's extended experiments with *Œnothera*, only 1.5 per cent. of the plants were mutative, and mutation is undoubtedly more common in cultivation than in the wild, and the mutated individuals are more likely to persist. The investigator should employ only statistical methods of comparison. He should contrast unit-characters, rather than individuals as a whole. Moreover, not only are the numbers of mutating individuals relatively uncommon, but the species may not now be in a mutative epoch.

In other words, there are epochs in the history of the plant when mutations occur. These are the 'mutation-periods' of De Vries. There are epochs of non-mutations, when no progress seems to be making. It may be conceived that some force is then withholding or restraining the mutative impulse. This force is what we are in the habit of calling heredity. When heredity is overcome, there arises a 'premutation-period,' in which the mutations are beginning to express themselves; and eventually the full mutation-period may appear. Heredity and non-heredity, these are the ever-opposing and ever-contrasting forces of organic life, the one resulting in the survival of the like, the other resulting in the survival of the unlike. One is heredity; the other is variation. One makes for continuity; the other for evolution. No hypothesis of the energy of evolution is perfect that does not account for both. A theory of heredity, or continuity, must also account for the opposite of itself. It is not easy to construct an hypothesis or a metaphor that will accomplish this.

The phenomena of continuity and discontinuity are well contrasted by Korschinsky. These phenomena, he conceives, are the results of two antagonistic tendencies. Under normal or usual conditions heredity is the stronger force. The tendency to vary is always present, being predisposed by environment but not caused by it; when it gathers the necessary energy it overbreaks the power of inheritance and sudden variations or sports arise, and these sports are the starting-points of evolution. This sudden appearing of new forms is called by him heterogenesis.

The conceptions of *per saltum* variations of Korschinsky and De Vries seem to be practically identical. De Vries has carried his work further, into the realm of actual experimental investigation. He studied many species of plants in the hope of finding one or more that might be in its mutation-period. Finally, he chose the common evening primrose, *Œnothera Lamarckiana*, and by continual sowing of seeds and raising of great numbers of plants he discovered several truly mutative forms. These forms reproduce themselves by means of seeds as accurately as accepted species do. He has given them specific names. The full

experimental history of them is given in the first volume of his brilliant work, 'Die Mutationstheorie.' These forms, he contends, are true elementary species. That is, they have new specific characters. These characters are heritable. It does not matter whether these characters are large or small—they become phylogenetic. These plants having the new specific characters may not be species in the Linnæan or historic or morphological sense, but they are real entities. We must give up the historical view of species when we study the evolution of organic forms. Historic or Linnæan species are taxonomic conceptions; the evolutional or elementary species are physiological conceptions.

The different categories of species, as respects their origin, are given as follows by De Vries:

A. Origin by means of formation of new characters, or progressive species-origin.
B. Origin without formation of new characters.
   1. By the becoming latent (*latentwerden*) of present characteristics, or retrogressive species-origin. Atavism in part belongs here.
   2. By the becoming active (*activirung*) of latent characteristics, or degressive species-origin.
      (*a*) Taxonomic anomalies.
      (*b*) Real atavism.
   3. By means of hybrids.

It will now be seen that the mutation theory of De Vries, which is in some respects a rephrasing and an extending of the old idea of sports, does not of itself introduce any new theory of the dynamics of evolution. It is not a theory of heredity nor of variation. His hypothesis of 'intracellular pangenesis' carries the explanation of these phenomena one step farther back, however. The plant cells give off pangenes. Each of these pangenes divides into two. Ordinarily, these two resemble the parent; but now and then one of them takes on a new character—the two become unlike—and gives rise to a mutation. This hypothesis, like Darwin's pangenesis, is useful as a graphic basis for discussion, whether or no it has real physiological foundation.

The most emphatic points of the mutation theory, as they appeal to me, are these: (1) It classifies variation into kinds that are concerned in evolution and kinds that are not; and thereby it denies that all adaptation to environment makes for the progress of the race. (2) It denies the power of natural selection to fix, to heap up or to augment differences until they become truly specific. (3) It separates the results of struggle for existence and survival of the fittest into two categories, only one of which has an effect on phylogeny. (4) It asserts that evolution takes place by steps, small or great, and not by a gradual unfolding or evolving of one form into another. (5) It enforces the importance of critical comparative study of great numbers of individual plants or animals. (6) It challenges the validity of the customary conception of species as competent to elucidate the method of evolution.

There will arise confusion, in the forthcoming discussions of the theory of discontinuity, as to what is a species; but this confusion is not new. There are two conceptions of species: (1) As taxonomic groups, more or less arbitrarily made for purposes of classification; (2) as real things, marked by recordable differences, however small or great, and conceived to be the actual steps in the phylogeny of the race. These categories are so distinct that they would not be confounded except for the unfortunate circumstance that we use one word (species) for the two. There has been a growing conviction that the two

classes must be sharply separated when evolution questions are discussed. Nearly ten years ago I endeavored to combat the species-dogma from the garden point of view, as, in differing ways, others had done before ('Survival of the Unlike,' Essay IV.). The confusion of the two conceptions expresses itself in the terminology of plant-breeding. Some writers define hybrid, for example, as a cross between species; this is the classificatory idea. Others define it to be any cross. The former use of the word is the more proper merely because it is the historic use, originating as a systematist's concept. The latter idea should have been expressed by a new word. It is for this reason that I have held to the old or systematic definition of hybrid; but there is no appeal against usage, so, while still proclaiming the righteousness of my cause as an easement of my conscience, I strike my colors and henceforth use the word hybrid for a cross of any kind or degree. How often does mere language confuse us!

From an argumentative point of view, it will be difficult to determine, in a given case, just what are variations and what mutations, for these categories are separated not by any quantitative or qualitative characters—the 'step' from one to the other may be ever so slight—but by the test that one kind is fully heritable and the other only partially so. If a mutation is to be defined as a heritable form, then it will be impossible to controvert the doctrine that evolution takes place by mutation, because the mutationist can say that any form that is inherited is by that fact a mutation. This will be equivalent to the position of those who, in the Weismannian days, denied the transmission of acquired characters, but defined an acquired character to be one that is not transmissible. However, it is to be hoped that the discussion of the mutation theory will not degenerate into a mere academic debate and a contention over definitions. Professor De Vries has himself set the direction of the discussion by making actual experiments the test of the doctrine. There will be confusing points, and times when we shall dispute over particular forms as to whether they are variations or mutations; but every one who has studied plants from the evolution point of view will be prepared to believe that species do originate by mutation. For myself, I am a Darwinian, but I hope that I am willing to believe what is true, whether it is Darwinian or anti-Darwinian. My own belief is that species do originate by means of natural selection, but that not all species so originate. De Vries's work will have a profound and abiding influence on our evolution philosophies.

II. HEREDITY: MENDEL.

De Vries made a thorough search of the literature of plant evolution. In an American publication he saw a reference to an article on plant hybrids by G. Mendel, published in 1865 in the proceedings of a natural history society of Brünn in Austria. On looking up this paper he was astonished to find that it discussed fundamental questions of hybridization and heredity and that it had remained practically unknown for a generation. In 1900 he published an account of it; and this was soon followed by independent discussions by Correns, Tschermak and Bateson. In May, 1900, Bateson gave an abstract of Mendel's work before the Royal Horticultural Society of England; and later the society published a translation of Mendel's original paper. It is only within the present year, however, that a knowledge of Mendel's work has become widespread in this country. Perhaps the two agencies that have been most responsible for dissemination of the Men-

delian ideas in America were the instruction given by Webber and others in the Graduate School of Agriculture at Columbus last summer, and the prolonged discussion before the International Conference on Plant-Breeding at New York last fall. Lately, several articles on the subject have appeared from our scientific press.

Mendel's work is important because it cuts across many of the current notions respecting hybridization. As De Vries's discussions call a halt in the current belief regarding the gradualness and slowness of evolution, so Mendel's call a halt in respect to the common opinion that the results of hybridizing are largely chance and that hybridization is necessarily only an empirical subject. Mendel found uniformity and constancy of action in hybridization; and to explain this uniformity he proposed a theory of heredity.

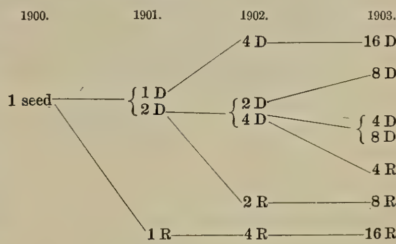
One of the most significant points connected with Mendel's work is the great pains he took to select plants for his experiments. He believed that hybridism is a complex and intricate subject, and that, if we are ever to discover laws, we must begin with the simplest and least complicated problems. He was aware of the general belief that the most diverse and contradictory results are likely to follow any hybridization. He conceived that some of this diversity may be due to instability of parents rather than to the proper results of hybridizing. He also saw that he must exclude all inter-crossing in the progeny. Furthermore, the progeny must be numerous, for, since incidental and aberrant variation may arise in the plants, it is only by a study of averages of large numbers that the true effects of the hybridizing are to be discovered. Moreover, the study must be more exact than a mere contrasting and comparing of plants: character must be compared with character.

The garden pea seemed to fulfill all the requirements. Mendel chose well-marked horticultural races or varieties. These he grew two years before the experiment proper was begun, in order to determine their stability or trueness to type. When the experiments were finally begun, he used only normal plants as parents, throwing out such as were weak or aberrant. Peas are self-fertile. It is to be expected that under such conditions the hybrid offspring would show uniformity of action; and it did.

In order to study the behavior of the hybrids, it was necessary to choose certain prominent marks or characters for comparison. Seven of these characters were selected for observation. These marks pertain to seed, fruit, position of flowers and length of stem, and they may be assumed to be representative of all other characters in the plant. These characters were paired (practically opposites) as long-stem *vs.* short-stem, round-seed *vs.* angular-seed, inflated-pod *vs.* constricted-pod. They were 'constant' and 'differentiating.' Of course every parent plant possessed one or the other of every pair of contrasting characters, but in order to facilitate his studies Mendel chose a different set of parents for each character, studying seed-shape in one set of hybrids, seed-color in another, pod-shape in another; in this way he avoided much complication in the results. Since it is not my purpose to discuss Mendel's work in detail, but only the general significance of its results, as they appeal to me, I need not describe these characters here. It will be sufficient for my purpose if I choose only one, the shape of the seed.

The seed-shape characters were roundness and angularity—the former being the 'smooth' pea of gardeners, and the latter the 'wrinkled' pea. Let us suppose that twenty-five flowers on round-seeded plants

were cross-pollinated in the summer of 1900 with pollen from angular-seeded plants, or *vice versa,* and that an average of four seeds formed in each pod. With the death of the parent plants the old generation ended, and the 100 seeds that matured in 1900—the year in which the cross was made—began the next generation; and these 100 seeds were hybrids. Now, all these 100 seeds were round. Roundness in this case was 'dominant.' (Dominance pertaining to the vegetative stage of the plant of course would not appear until 1901, when the seeds 'grow.') These seeds are sown in the spring of 1901. If each seed be supposed to give rise to four seeds—or 400 in all—this next generation of seeds (produced in 1901) will show 300 round and 100 angular seeds. That is, the other seed-shape now appears in one fourth of all the progeny; this character is said to have been 'recessive' in the first hybrid generation. If the 100 angular seeds, or recessives, are sown in 1902 it will be found that all the progeny will be angular-seeded or will 'come true'; and this occurs in all succeeding generations, providing no crossing takes place. If the 300 round seeds, or dominants, are sown in the spring of 1902, it will be found that 100 of them produce dominants only, and that 200 of them behave as before—one fourth giving rise to recessives and three fourths to dominants; and this occurs in all succeeding generations, providing no crossing takes place. In other words, the three fourths of dominants in any generation are of two kinds,—one third that produce only dominants and two-thirds that are hybrids. That is, there is constantly appearing from the hybrids one fourth part that are recessives, one fourth part that are constant dominants, and one half part that are dominants to all appearances, but which in the next generation break up again into dominants and recessives. This one half part that breaks up into the two characters consists of the true hybrids; but they are hybrids only in the sense that they hold each of the two parental characteristics—roundness and angularity—in their purity and not as blends or intermediates; and these two characteristics reappear in all succeeding generations in a definite mathematical ratio. Proportionally, these facts may be expressed as follows:



It will be seen that two thirds of the dominants break up the following year into one fourth constant dominants, one fourth recessives, and one half that again break up, the half that break up being the hybrids. This formula for the hybrids is Mendel's law. In words, it may be expressed as follows: Differentiating characters in plants reappear in their purity and in mathematical regularity in the second and succeeding generations of hybrid offspring of these plants; the mathematical law is that each character separates in each of these generations in one fourth of the progeny and thereafter remains true. In concise figures it is expressed as follows:

$$1D:2DR:1R.$$

$1D$ and $1R$ come true, but DR breaks up again into dominants and recessives in the ratio of 3 to 1.

Mendel found that this law holds more or less for the other characters that he

studied in the pea, as well as for the seed-shape. He did not conclude, however, that it holds good for all plants, but left the subject for further investigation. He himself found different results in *Hieracium.* It will be seen at once that it will be a very difficult matter to follow this law when many characters are to be contrasted, particularly when the characters are merely qualitative and grade into each other. The dominant characters pertain to either parent: some of them may come from the mother and some from the father.

When this roundness is dominant from the male parent, it falls under the denomination of what we commonly know as xenia, or the immediate effect of pollen; when it is from the female parent, there is no xenia. In the case of the pea, the seed-content is embryo and we are not surprised if there is xenia. In those plants in which the embryo is embedded in endosperm, however, it would seem to be difficult to account for xenial dominance, unless there is double fecundation, as appears to be the case in Indian corn, as pointed out by De Vries, Webber* and others. It looks as if the question of dominance would introduce a new point of view into the study of xenia. There is now a strong tendency, however, to use the word xenia to designate only those effects occurring outside the embryo.

Which characters will be dominant in any species we cannot determine until we perform the experiment; that is, there is no mark or attribute which distinguishes to us *a-priori* a dominant or a recessive character. However, the mere fact as to whether the one or the other character is dominant is relatively unimportant, for constant dominance is no more a regular behavior than recessiveness is. In various subsequent experiments it has been found that even when marked dominance is not shown in the first product, the hybridization may follow the law in essential numerical results. The really important points are two: (1) that the characters typically remain pure or do not bend, (2) and that their reappearance follows a numerical order.

*'Bull. 22, Div. of Veg. Phys. and Path.,' U. S. Dept. Agric., 1900.

After finding such surprising results as these, Mendel naturally endeavored to discover the reasons why. The product of his speculations is the theory of gametic purity (to use our present-day terminology), which is a partial theory of heredity. Every plant is the product of the germ cell fertilized by the sperm cell. When constant progeny is produced, it must be because the two cells, or gametes, are of like character. When inconstant progeny is produced, it must be because the sperm cell is of one character and the germ cell of another. When these unlike gametes come together, they will unite according to the law of mathematical probabilities, one fourth of those of each kind coming together and one half of those of both kinds coming together. If A and B represent the contrasting parental characteristics, they would combine as

$$\begin{aligned} A + A &= A^2 \\ A + B &= AB \\ B + A &= BA \\ B + B &= B^2 \end{aligned}$$

A^2 and B^2 are equivalent only to A and B. Since both of the opposed or contrasted characters can not be visible at the same time, we have the following:

$$\begin{array}{c} A \\ A^b \\ A^b \\ B \end{array}$$

in which small b represents the character that for the time being is not able to express itself, or is recessive, and large B represents the same character fully expressed.

In these gametes, the unit characters of the plants that bear them are pure. Even in hybrid plants, the pollen grains and the egg cells are not hybrids. According to this hypothesis of gametic purity, therefore, hybrids follow natural and numerical laws; but these laws are always obscured by new crossing. True intermediate characters do not occur. If new characters appear, it is because they have been recessive or latent for a generation or because the plant has varied from other causes: they are not the proper results of hybridization. Possibly new characters that appear because of effect of environment or other cause may be impressed on the gamete and thereby be perpetuated. The results of hybridization, then, according to the Mendelian view, are not fundamentally a mere game of chance, but follow a law of regularity of averages; but the results are so often masked that it is sometimes impossible to recognize the law.

Mendel's law of heredity is recently stated as follows by Bateson and Saunders: 'The essential part of the discovery is the evidence that the germ-cells or gametes produced by cross-bred organisms may in respect of given characters be of the pure parental types, and consequently incapable of transmitting the opposite character; that when such pure similar gametes of opposite sexes are united together in fertilization, the individuals so formed and their posterity are free from all taint of the cross; that there may be, in short, perfect or almost perfect discontinuity between these germs in respect of one of each pair of opposite characters.'

This, in barest epitome, is the teaching of Mendel. This teaching strikes at the root of two or three difficult and vital problems. It presents a new conception of the proximate mechanism of heredity, although it does not present a complete hypothesis of heredity, since it begins with the gametes after they are formed, and does not account for the constitution of the gametes nor the way in which the parental characters are impressed upon them. This hypothesis will focus our attention along new lines, and I believe will arouse as much discussion as Weismann's hypothesis did; and it is probable that it will have a wider influence. Whether it expresses the actual means of heredity or not, it is yet much too early to say; but this hypothesis is a greater contribution to science than the so-called 'Mendel law' as to the numerical results of hybridization; the hypothesis attempts to explain the 'law.'*

One great merit of the hypothesis is the fact that its basis is a morphological unit, or at least an appreciable unit, not a mere imaginary concept. This unit should be capable of direct study, at least in some of its phases. It would seem that the Mendelian hypothesis would give a new direction to cytological research.†

It is yet too early to say how far Mendel's law applies. We shall need to restudy the work that has been done and to do new work along more definite lines. There are relatively few results of experiments that can be conformed to Mendel's law, because the data are not complete enough or not made from the proper point of view. We should expect the fundamental results to be masked when the plants with which we work are themselves unstable, when cross-fertilization is allowed to take place, or when the pairs of contrasting characters are very numerous and very complex. Marked numerical results

* This, I take it, is also the opinion of Bateson, the leading interpreter of Mendel in English; for he calls his new book on the subject (1902) 'Mendel's Principles of Heredity,' as if the heredity idea were greater than the hybridization idea.

† See, for example, 'A Cytological Basis for the Mendelian Laws,' *Bull. Torr. Bot. Club*, 29, 657 (1902), by W. A. Cannon.

have been found by various workers in different fields, in this country notably by Spillman in hybrid wheats. Mendel was able to discover the numerical law because he eliminated nearly all of the confusing contingencies. In the discussion of every bold new hypothesis, we are in danger of becoming partisans, taking a stand either for it or against it. The judicial attitude is also the scientific one. We want to know.

Two processes are now going forward in the discussion of Mendel's law—one the explaining away of 'exceptions,' the other the endeavoring to find the true place of the law in the scheme of evolution. The one is primarily an effort to uphold the law; the other is primarily a desire to adjudge it. One is an effort to apply it universally; the other to determine whether it is universal. Already so many adjustments have been made of the Mendelian principles that it is becoming difficult to determine what Mendelism is. These cases are typical of the discussions on almost every vital question connected with evolution. At the hard places we make a supposition and modify the hypothesis in the face of a fact. We can prove anything by supposing.

The results of Mendel's work have two important bearings on current evolution discussion: (1) on the part that hybridization plays under natural conditions in the evolution of the forms of life, and (2) the part that it plays in plant-breeding. In the former category, Mendel's work gives a hint of definiteness to the rôle of hybridization in the origination of new combination-forms. In the latter category, it is difficult as yet to measure its importance, since extended applications to practice have not been made and since, also, the Mendelian principles have been so much extended and redefined within the past two years that it is difficult to determine just what is Mendelism and what is an endeavor to make the Mendelian suggestions fit our present-day knowledge. In discussing the application of Mendel's work to plant-breeding, I desire to keep in mind the work that he did with peas, upon which the 'Mendel law' chiefly rests.

III. APPLICATION TO PLANT-BREEDING.

The wildest prophecies have been made in respect to the application of Mendel's law to the practice of plant-breeding, for the mathematical formulæ express only definiteness and precision. Unfortunately, the formulæ can not express the indefiniteness and the unprecision which even Mendel found in his work. My own feeling is that the greatest benefit of Mendel's work to the plant-breeder will be in improving the methods of experimenting. We can no longer be satisfied with mere 'trials' in hybridizing: we must plan the work with great care, have definite ideals, 'work to a line,' and make accurate and statistical studies of the separate marks or characters of plants. His work suggests what we are to look for and new ways of attacking difficult problems.

Beyond this, I do not see how the original Mendelian results will greatly modify our plant-breeding practice. The best breeders now breed to unit characters, for this is the significance of such expressions as 'avoid breeding for antagonistic characters,' 'breed for one thing at a time,' 'know what you want,' 'have a definite ideal,' 'keep the variety up to a standard.' In certain classes of plants the Mendelian laws will be found to apply with great regularity, and in these we shall be able to know beforehand about what to expect. The number of cases in which the law, or some modification of it, applies is being extended daily, both for animals and plants (see, for example, Bateson and Saunders' report to the Royal Society on heredity);

but in practice we shall probably find many more exceptions to the formulæ than confirmations of them, even though the exceptions can be explained, after we find them, by Mendel's principle of heredity.

It has been said that we shall soon be able, as a result of Mendel's discoveries, to predict varieties in plant-breeding. Before considering this question, we must recall the fact that a cultural variety is a succession of plants that have characters sufficiently marked and uniform to make it worth cultivating in place of some older variety. Now and then it may be worth while to introduce some new energy or new trend into a general lot of offspring by making wholesale crosses, not expecting ever to segregate any particular variety or strain from the progeny; but these cases are rare, and the gain is indefinite and temporary. So far as our knowledge at present goes, I see no warrant for the hope that we can predict varieties with any degree of exactness, at least not beyond a very narrow effort. Following are some of the reasons that seem to me to argue against the probability of useful prophecy of varities, so far as the Mendelian results are concerned: (1) We do not know what plants will Mendelize until we try. (2) Even in plants that do Mendelize, only half of the offspring have stable characters. But we can not predict for even this half, for it is impossible to determine beforehand which seeds showing dominant characters (and these are three fourths of the offspring) will 'come true.' Dominance, as we have seen, is of two kinds in respect to its behavior in the next generation—constant and hybrid; and the hybrid dominance, which is twice as frequent as the other, breaks up into constant dominance, hybrid dominance and recessiveness. (3) Mendel's law deals primarily with mere characters, not with a variety or with a plant as a whole. Every plant is a composite of a thousand characters, and from the plant-breeder's point of view there may be as many undesirable characters as desirable ones. No plant is perfect; if it were there would be no need of plant-breeding. The breeder wants to preserve the desirable characters or traits and eliminate the undesirable ones, but under the strict interpretation of Mendelism this is difficult. The one germ gamete and the one sperm gamete that unite to make the new plant each contain all the alternative characters; these characters are bound to reappear in the offspring, and all that the breeder gains is a new combination or arrangement of characters, and undesirable attributes may be as troublesome as before. (4) The breeder usually wants wholly new characters as well as recombinations of old ones, or he wants augmented characters. For example, a carnation grower wants a four-inch flower, but he has only three-inch flowers to work with, and augmentation of characters is no part of the original Mendelian law. Perhaps these augmented and new characters are to be got by means of ordinary variation and selection, or other extra-crossing means; but we know, as a matter of fact, that augmented characters do sometimes appear in hybrids. (5) New and unpredictable characters are likely to arise from the influence of environment or other causes, and these may be recorded in the gametes and vitiate the final results. (6) Variability itself may be a unit character, and therefore pass over. There is probably such a thing as a 'tendency to vary,' wholly aside from the fact of variation. (7) Many of the plants with which we need most to work in plant-breeding are themselves eminently variable, and the results, even if there is true Mendelism, may be so uncertain as to be wholly unpredictable. (8) Many plants with which we must work will not close-fertilize. Some

of them are monœcious or diœcious. Even if there is gametic purity in such plants, the probability is that the fact can be discovered only by a long line of scientific experimenting for that particular purpose, and not by the work of the man who desires only to breed new plants. (9) A cultural variety, in any true acceptation of the term, is a series of closely related plants having a pedigree. It runs back to one individual plant, from which propagation has been made by seeds or asexual parts. Now, one can never predict just what combination of characters any plant will have, even though it be strictly Mendelian. A person might have a thousand plants of peas of which no one plant shows any of the characters in the proportion of 3 to 1, let alone all the characters as 3 to 1; and yet the total average numerical results might conform exactly to the Mendelian law. Mendel's law is a law of averages. The very fact that one must employ such large numbers to secure the numerical results shows that we can not predict as to individuals. For example, in ten plants of pea, Mendel found the following ratios in respect to seed-shape and seed-color:

Shape.	Color.
3.75:1	2.27:1
3.37:1	4.57:1
3.43:1	2.80:1
1.90:1	2.59:1
2.91:1	1.85:1
4.33:1	3.33:1
3.66:1	2.43:1
2.20:1	4.88:1
4.66:1	3.57:1
3.57:1	2.44:1

Mendel reports one instance in which the ratio in seed-shape was 21 to 1, and another of 1 to 1. He also reports instances of seed-color of 32 to 1 and 1 to 1. It has been said that, because of Mendel's work, we shall be able to produce hybrid varieties with the same certainty that we produce chemical compounds. Now, a plant is made up of many combinations of many units, and these combinations are the results of mathematical chance or probability. Chemical compounds are specific entities, in which the parts combine by mathematical definiteness. The comparison, as it appeals to me, is fallacious and the conclusions unsound.

We must remember that there are whole classes of cases of plant-breeding that do not fall under hybridization at all. Granting the De Vriesian view that selection is incompetent to produce species from individual fluctuations, it is, nevertheless, well established (and admitted by De Vries) that very many of our most useful cultural varieties have been brought to their present state of perfection by means of selection; and by selection they are maintained in their usefulness. Selection will always be a most important agency in the hands of the gardener—none the less so now that we have challenged its rôle in the evolution of the plant kingdom. For the time being, the new discussions of hybridization are likely to overshadow all other agencies in plant-breeding; but selection under cultivation is as important now as it was in the days of Van Mons and Darwin.

IV. INTERPRETATION OF HYBRIDISM.

I believe that the clearest insight into this whole new question of hybridization is to be got by following the work of De Vries. The concluding parts of the second volume of his 'Mutationstheorie,' a volume devoted wholly to hybridization, is on the press at this moment. The Mendelian laws are fully discussed in this volume, but the summary conclusions may be presented here. De Vries had been working at hybridization long before he discovered Mendel, and had arrived at practically the same results; he had also arrived at other results

that are not Mendelian. De Vries denominated the law of numerical segregation as the 'law of separation of characters in crosses.' Like Mendel, he had found that merely to cross 'varieties' or 'species' is of no avail in the study of fundamental problems; for the varieties and species that we know are mere systematic groups with characters of all kinds and degrees. We must cross characters or units, not species.

Now, every unit character he conceives to be represented in the germ by a pangene. This pangene may be active, in which case the character appears in the plant; or it may be dormant, in which case the character is not visible, or for the time being is lost. Active pangenes may at any time become latent, or latent ones may become active.

Mendel's law results from an interchange of contrasting characters. True physiological or elementary species differ from each other by new unit characters. They have arisen by progressive mutation. The characters are not contrasting or differentiating. One species has one kind of pangene, another species another kind of pangene. On combining these there can be no interchange of characters, and therefore no Mendelism. There is nothing for one character to exchange against the other. In the case of true progressive mutations, therefore, upon which the progress of the plant race depends, there can be no Mendelizing. Hybrids of these cases are intermediates, or else follow only one or the other of the parents.

Now, varieties differ from true mutative species in the fact that they have contrasting characters. These characters are represented by their special kinds of pangenes. The pangene may be active or passive. That is, the variety may be a variety because one or more of its characters has become latent (retrogressive) or because characters have become active (degressive). When these characters are crossed, there is an interchange of the pairs. Both parents bear the same unit character, but this character is active in the one and dormant in the other. The hybrid receives an active pangene from one parent and a similar but inactive pangene from the other. When these two units unite, the calculus of chance determines that there shall reappear in the second generation equal numbers of both the parental units, and half of the whole that are still hybrids and break up in the same ratio in the third generation. That is, true Mendelism is confined to crossings of retrogressive and degressive varietal characters.

There are, therefore, two general classes of hybrid formation—the isogons, giving rise to crosses in which two antagonistic parental characters reappear in numerical order (Mendelian cases); anisogons, giving rise to crosses in which two antagonistic sometimes separate unequally, but ordinarily do not separate at all. When only one parent is represented in the offspring, we have the 'unisexual crosses' of Macfarlane or the 'false crosses' of Millardet. These are cases in which there are no true contrasting characters. Spillman has recently explained the false hybrids by supposing that the plants in this case are self-fertile and sterile with other pollen. That is, A is fertile with A, B with B, but A is not fertile with B nor B with A; there results, therefore, no true crossing. This hypothesis should be capable of experimental proof or disproof.

The isogon hybrids are of all degrees of complexity, and classification of them will at once show how far we have already got away from the old systematic idea of variety-hybrids and species-hybrids. Hybrids between plants that differ only in one unit-character are monohybrids. These

are the ones in which the numerical results are most clearly traced, but they are also exceedingly rare. Those in which two unit characters are concerned are dihybrids. In these the combination series gives four different kinds of offspring. So there are trihybrids, giving eight possible combinations, tetrahybrids, and so on to polyhybrids; and in every succeeding grade the difficulties of statistical and comparative studies increase. Of how many characters is a plant composed?

V. CONCLUSION.

Now, in conclusion, what are the great things that we have learned from these newer studies? (1) In the first place, we have been brought to a full stop in respect to our ways of thinking on these evolution subjects. (2) We are compelled to give up forever the taxonomic idea of species as a basis for studying the process of evolution. (3) The experimental method has finally been completely launched and set under way. Laboratory methods, comparative morphology, embryological recapitulation, life history studies, ecological investigations—all these means are likely to be overshadowed for a time by experiments in actually growing the things under conditions of control. (4) We must study great numbers of individuals and employ statistical methods of comparison. (5) The doctrine of discontinuous evolution is now clearly before us. (6) We are beginning to find a pathway through the bewildering maze of hybridization.

L. H. Bailey.

Cornell University.

THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

The sixth regular annual meeting of this society was held, in conjunction with the meetings of the American Society of Naturalists and the American Association for the Advancement of Science, at Washington, December 30 and 31, 1902, under the presidency of Professor Volney M. Spalding. A large part of the members were in attendance, and the meeting was in all ways most successful and pleasant. New members were elected as follows: Messrs. W. A. Cannon, of the New York Botanical Garden; Judson F. Clark, of Cornell University; G. P. Clinton, of the Connecticut Agricultural Experiment Station; W. C. Coker, of the University of North Carolina; C. C. Curtis, of Columbia University; E. J. Durand, of Cornell University; J. E. Kirkwood, of Syracuse University; W. A. Orton, of the United States Department of Agriculture, and K. M. Wiegand, of Cornell University. The following officers were elected for the ensuing year:

President—Roland Thaxter, of Harvard University.

Vice-President—Conway MacMillan, of the University of Minnesota.

Secretary-Treasurer—W. F. Ganong, of Smith College.

The chief item of business of general interest was the discussion upon the practicability and desirability of the new Central Bureau 'for the obtaining and distribution of material for investigation and demonstration' proposed by the Association Internationale des Botanistes. An expression of opinion taken after the discussion showed a unanimous opinion against the plan. Suggestions were formulated towards securing further improvements in the *Botanisches Centralblatt*, and a committee was appointed to draw up and publish in Science and elsewhere a statement to American botanists of the desirability of giving their full support to the *Centralblatt*, and of declining to support a competing journal.

The social features of the meeting were of unusual attractiveness. The society joined with the other societies in the vari-

ous public entertainments which had been arranged by the American Association, and in addition two notable courtesies were extended to the visiting members of the society by botanists of Washington—the first, a charming dinner at the Hotel Barton, given to the visiting members of the society and their wives by the Washington members and their wives on Tuesday evening, and a reception later the same evening given to all the visiting botanists by the Botanical Society of Washington.

The address of the president, Professor Volney M. Spalding, dealt with 'The Rise and Progress of Ecology,' and was delivered after the dinner at the Hotel Barton. It is believed to be the first presidential address to deal with this subject. It was published in full in this journal for February 6.

The society voted to extend its warmest thanks to the authorities of Columbian University, to its members resident in Washington and to the Botanical Society of Washington, for the many courtesies which had contributed to make the meeting so successful and enjoyable.

Following are abstracts of the papers actually presented in full before the society and thrown open for discussion, excluding those offered by title. The abstracts are by the authors. Certain papers appear by members of the new Association of Botanists of the Central States, the sessions being to some extent joint ones with that association.

A Discussion of Mendel's Law and its Bearings: Professor L. H. BAILEY, Cornell University, and Dr. HERBERT J. WEBBER, Department of Agriculture.

Professor Bailey's paper is published above. It is expected that Dr. Webber's paper will also be published in this journal.

The Early Root Development of Tree Seedlings, an Important Factor in their Local Distribution: Professor J. W. TOUMEY, Yale Forest School.

A series of twenty slides were shown of the initial root systems of various root types of seedlings of American trees, photographed in various stages of germination, and at different later periods until the species had grown well-developed initial root systems. All of the seedlings were grown at approximately the same time and under the same soil and atmospheric conditions.

From the study of the root systems of the various species, it appeared that the form of the initial root systems of the trees studied is surprisingly constant for the same species. In other words, there is an inherent tendency for each species to produce an initial root system that takes a definite form and direction. Early in the life of the seedling, this initial root system becomes more or less modified by its environment, particularly by the moisture and other soil factors. It was shown that there are great differences in the different species studied in the plasticity of the initial root system; that is, in the rapid and marked changes from its initial form and characteristics under the influence of environment. In some of the species shown, as in many hickories and oaks, the initial root system has remarkable fixity. The general form of the initial root persists, no matter upon what soil the species grows. It was pointed out that the species which show but little plasticity in the initial root system under the influence of environment, do not readily adapt themselves to variable soil moisture conditions.

In others of the species shown the initial root system is extremely plastic, rapidly changing under environmental influence, as illustrated in the red maple. In this species the initial root system consists of

the long tap-root and a few strong lateral roots very near the surface of the soil. In wet situations the tap-root soon disappears, and the plant becomes surface-rooted from the development of the lateral roots. In a dry situation the tap-root persists and the initial lateral roots disappear. Trees exhibiting this plasticity readily adapt themselves to a great diversity of situations as to soil and moisture. Thus we find the red maple grows in swamps, and also on dry rocky ridges.

It was further shown that the form and behavior of the initial root system, in its development prior to its becoming materially modified under the influence of environment, is directly correlated with the soil moisture conditions best suited to its growth and development. It appears possible to classify our woody plants into groups based upon differences in form and development of their initial root systems, and their plasticity under the influence of environment, and judge, with a fair degree of accuracy, the locality as to soil moisture best suited to each group.

Observations on a Hitherto Unreported Bacterial Disease, the Cause of which enters the Plant through Ordinary Stomata: Dr. Erwin F. Smith, Department of Agriculture.

A disease of Japanese plums of unusual interest has made its appearance in central Michigan. It is first visible in the form of numerous small water-soaked spots on the leaves and green fruits. The leaf disease ends in 'shot-holes'; the fruit disease ends in roundish, sunken, shallow black spots and in deep fissures which spoil the plums. The spots enlarge slowly, but may finally reach a diameter of one fourth to one half inch. The disease is due to a yellow bacterium, *Pseudomonas pruni* Smith, *which enters the uninjured plant through ordinary stomata.* In the earliest stage of the disease, visible only under the compound microscope in properly fixed and sectioned material, the bacteria are confined to the substomatic chamber. From this point they push into the deeper tissues, and by the time the spots have become large enough to be seen under a hand lens (as small water-soaked areas—one fifth to one half mm. in diameter), the bacteria have multiplied enormously in the depths, pushing up the epidermis and the cells immediately under it, and forming in the deeper tissues closed cavities of considerable size. Later, when the enlarged spots have begun to sink in and become brown, the bacteria reach the surface as numerous tiny, rounded, pale-yellow, gum-like masses, which ooze from the stomata lying over the closed bacterial cavity. The infections take place principally in May and June and no wounds are necessary. The shaded and west side of the fruits are most subject to infection, *i. e.*, those on which the rain drops or dew drops (necessary for infection) would persist longest because best protected from the morning sun. This is primarily a disease of the parenchyma, but the bundles are finally invaded.

The organism is distinctly yellow and grows readily in ordinary culture media, bouillon, milk, potato, agar, etc. It was easily obtained in pure culture from small spots. In agar plate cultures it looks much like *P. campestris,* but is readily distinguished by its feebler growth on potato and by its behavior in Uschinsky's solution, which is converted by it from a limpid fluid to one as viscid as egg albumen. The bacteria are small to medium size and occur singly, in pairs, or short chains. They are motile by means of one to several polar flagellæ. The thermal death point is approximately 51° C. Gelatin is not liquefied rapidly. Litmus in milk is reduced, but finally returns to its

former color. Casein is slowly precipitated and finally redissolved. No gas is produced from any medium.

The paper was illustrated by fifty lantern slides showing the location of the bacteria in the tissues and illustrating the morphology and cultural characters of the organism.

Completed Proof that P. Stewarti is the Cause of the Sweet Corn Disease of Long Island: DR. ERWIN F. SMITH, Department of Agriculture.

In the winter of 1897–98, Stewart described a disease of sweet corn from Long Island which he attributed to a yellow bacterium that was very abundant in the vessels. This organism Smith subsequently named *P. Stewarti*. Stewart's infection experiments were inconclusive partly because made in a locality where the disease occurred naturally and soon appeared on the check plants, and partly because not made in the most natural way.

In the summer of 1902 the writer visited Long Island and obtained pure cultures of the organism. With these about 500 sweet corn plants of several varieties were inoculated, all during the seedling stage. Part of these plants were exposed to infection by placing the bacteria in drops of fluid oozing from the water-pores at the tip of the leaf, part by shaking up slant-agar cultures in sterile water and spraying this on the plants in a fine mist, during the period when they were extruding water from their leaf-tips. Both methods yielded good results. The first shriveling of tissue was at the tips of the inoculated leaves. Typical constitutional symptoms appeared in a few plants during the first month, but most of the cases developed the second and third month when the plants were several feet high. In such it was common to find the vascular system plugged with this yellow bacterium in practically pure culture all the way from the basal nodes to the top of the plant, four and one half feet in some cases. The nodes of such plants were browned inside very decidedly, especially the basal ones; the internodes within were generally white, with yellow bundles from which the bacteria oozed abundantly on cross-section. Frequently 150 or more bundles would be occupied. More than 300 typical cases of this disease were obtained, and many other plants would undoubtedly have shown symptoms had not the experiment been cut short by a frost. One of the first symptoms of this disease is the whitening and death of the male inflorescence. The leaf blades dry out one after another until all are dry, while the stem is still green. In this condition the affected plants look as if frosted, and the cause of the disease is not apparent until the plants are cut open.

This experiment, conducted in Washington, where the disease does not occur, shows conclusively that wounds are not necessary for infection, *and makes it reasonably certain that natural infections take place as a rule through the water-pores or ordinary stomata in the seedling stage of the plants.* The vascular system is the primary seat of the disease, but small cavities filled with the bright yellow slime finally appear in the parenchyma. The bacteria were not confined to the stem but passed out into the vascular system of the blades of the middle and upper leaves and into vessels of the husks and cobs. The paper was illustrated by lantern slides.

Opportunities for Study at the Minnesota Seaside Station: Professor CONWAY MACMILLAN, University of Minnesota.

The speaker gave an account of the surroundings of the station, the particularly rich marine flora, and the advantages offered for investigation in this compara-

tively new field, illustrating the subject fully by lantern slides.

On the 'Blue' Color of Coniferous Timber: Dr. Hermann von Schrenk, Missouri Botanical Garden.

Following an attack of the destructive pine bark beetle in South Dakota, the sapwood of the bull pine (*Pinus ponderosa*) turned blue. The color first appears at the base of the tree some months after the beetle attack, and gradually spreads up the trunk until it has reached the top. The color is evenly distributed throughout the sapwood, and is very permanent. Reference was made to the researches of Vuillemin on the 'green' color of wood, which he found due to a substance, *xylindeine,* formed by *Helotium aeruginascens.* The 'blue' color of pine wood is due to the growth in the wood of *Ceratostomella pilifera,* the fruiting bodies of which grow on the outside of affected wood. The life history of the fungus was described and cultures exhibited. No coloring matter could be extracted from 'blue' wood, and it is probable that the color is largely due to the blending of the brown color of the fungus present throughout the 'blue' wood, with the color of the wood itself. The 'blue' wood was shown to be as strong mechanically as green wood.

The Development of the Prothallium in Pinus: Dr. Margaret C. Ferguson, Wellesley College.

A few of the more important conclusions reached in a detailed study of the development of the prothallium in *Pinus* were given.

The ovules are not differentiated in the species of pines studied until about three weeks before pollination.

The macrospore-mother-cell may originate from a hypodermal cell as ordinarily stated, but in a study of the development of the ovule there is not the slightest evidence of such an origin.

The first division of the macrospore-mother-cell is heterotypical in nature and gives rise to the one half number of chromosomes. This division is quickly followed either in the lower cell only, or in both cells, by a homotypical division, thus giving rise to axial rows of three or four cells. The basal cell results from a true tetrad-division, and always forms the functional macrospore.

The macrospore passes through a period of growth lasting about six weeks. During this time the peripheral layer of cytoplasm is organized and the nucleus takes up a position in the wall-layer of cytoplasm near the micropylar end of the cell.

Thirty-two free nuclei are formed before the approach of winter, and more than two thousand nuclei have been counted at the time when cell-walls are laid down. In the later development of the prothallium, true 'alveoli' are not formed, but each cell divides several times before reaching the center of the prothallial cavity.

The 'spongy tissue' is not disintegrating tissue, as previously stated, but it forms a zone of physiological tissue which plays an important part in the nutrition and support of the developing gametophyte.

Fertilization in Taxodium: Professor W. G. Coker, University of North Carolina.

The male gametophyte of *Taxodium* is much like that of the Cupresseæ. No sterile prothallial cell is formed, and the pollen-tube reaches the archegonia before the division of the central cell occurs. This division takes place simultaneously with the ventral-canal division in the archegonium, and in a day or two fertilization is completed. The sperm-cells are of equal size, and, as a rule, each is instrumental in fertilizing an archegonium. In outline the sperm-cells resemble those of

the Cupresseæ and *Sequoia*. They are sharply separated from the protoplasm of the pollen-tube by a distinct hautschicht. Immediately around the nucleus is a thick layer of starch; next to this peripherally comes an imperfect layer of granular material staining red in saffranin which is probably of the same nature as the large masses found in the spermatozoids of *Ginkgo*. Between this layer and the hautschicht is a narrow zone of clear protoplasm without appreciable inclusions. In the Abieteæ the pollen-tube contains starch, but there is none in the sperm-cells themselves, while in *Taxodium*, on the contrary, the pollen-tube is free from starch and the sperm-cells are loaded with it.

The ventral-canal division in the archegonium does not produce a ventral-canal cell, separated from the egg, but simply cuts off a ventral-canal nucleus which, while closely pressed to the surface of the egg, is still included in its protoplasm. This nucleus is rarely cut off at the very tip of the egg, but is generally lateral in position and may even be half way down the side. It does not degenerate at once, but persists until after fertilization, and then generally divides amitotically.

In fertilization the entire sperm-cell enters the egg, passes through its protoplasm, and comes in contact with the egg nucleus, around which it folds. The starch is thus distributed evenly around the fusion nucleus and sinks to the base of the archegonium with it, to be included in the small amount of protoplasm cut off at the base of the egg as the proembryo. In *Taxodium*, then, almost the whole of the included food material and a considerable part of the protoplasm of the embryo are derived from the sperm-cell, while only a small part of the protoplasm of the egg is instrumental in embryo formation, the remainder being digested and absorbed by the young plant. Such a type of fertilization is known so far only in the group Taxodieæ.

Stamens and Pistils are Sexual Organs: Professor W. F. GANONG, Smith College.

The author contended that the current effort to restrict the sex-terminology to the gametophyte in the flowering plants is misdirected, for not only does the sex-terminology belong to stamens and pistils on the ground of priority, but also as a matter of physiological fact. The paper will appear in full in this journal.

The Toxic Effects of Some Nutrient Salts on Certain Marine Algæ: Professor BENJAMIN M. DUGGAR, University of Missouri.

Some work conducted in part at the Naples Marine Biological Laboratory and in part at Woods Holl was reported. In attempting some osmotic studies with solutions of cane sugar, potassium nitrate and sodium chloride, it was found that with isotonic solutions, either in sea water or in distilled water, the results were unusually inconsistent. It seemed probable that the explanation might be found to be connected with the toxic action of the salts used. Accordingly, an investigation was attempted of the toxic action of certain nutrient salts found in sea water when added to sea water, other chemical agents being also used for comparison. Seven algæ were employed, namely, *Chætomorpha linum, Cladophora gracilis, Dasya elegans, Pleonosporium coccinium, Grinnellia Americana, Griffithsia Schousberi* and *G. opuntioides*. It is desirable to employ for such studies algæ which change color as soon as killed, or those with which the plasmolytic test may be readily employed.

After the acids and some of the salts of the heavy metals, the potassium phosphates proved most toxic; and the latter are closely followed by the neutral salts of ammonium, among which the sulphate is

most injurious. The last-mentioned are followed by some salts of potassium and calcium in irregular order, although it is to be noted that potassium nitrate is about twice as poisonous as potassium chloride. The least toxic are the salts of sodium and magnesium. An average of the experiments shows magnesium sulphate to be the least toxic of all salts which have been used as sulphates, chlorides or nitrates. The low toxicity of the magnesium salts with relation to the marine algæ makes it evident that these plants are very notable exceptions to the rule which Loew and others found to hold for many phanerogams and fresh-water algæ.

The toxicity of the salts studied bore no close relation to the relative amounts of these salts normally present in sea water. The inconsistent results with potassium nitrate and other salts as plasmolytic agents may be partially explained by the toxic action of these salts on the marine algæ.

The Nature and Function of the Pyrenoid: Mr. H. G. Timberlake, University of Wisconsin.

Among the structures found in the cells of the green algæ the pyrenoid occupies a doubtful position. The question as to whether it is to be considered a true cell-organ or a mere mass of reserve material is partly, but not wholly, solved by its history in connection with the various phases of the life history of the cell and its relation to the process of starch formation. That the pyrenoid may be reproduced by division is shown in the cells of *Cladophora*, *Œdogonium* and other filamentous algæ, as also in *Chlamydomonas* among the unicellular forms. In this latter case the pyrenoid divides during the division of the cell. On the other hand, it is well established that under ordinary circumstances the pyrenoids entirely disappear prior to spore formation in *Hydrodictyon* and are afterward formed anew in the young cells.

The relation of the pyrenoid to starch formation in *Cladophora* and other forms studied is essentially the same as that already described by the author for *Hydrodictyon* (*Annals of Botany*, December, 1901). The following additional details are noted: The usual shape of the pyrenoid in the species of *Cladophora* studied is that of a biconvex lens. The differentiation of the pyrenoid into two parts takes place in such a way as to divide it by a plane passing through its longer axis. In many cases the pyrenoid is actually split into halves with a fairly broad cleft between them. Either of the halves so formed may be converted into a starch grain. In some instances the entire pyrenoid is converted into starch without previous cleavage. This is more apt to happen in *Œdogonium* and *Rhizoclonium* than in *Cladophora*.

The nature of the chemical processes involved in the formation of starch from a pyrenoid is now under investigation. That the process involves a conversion of a proteid substance (the pyrenoid) into a carbohydrate (starch) seems reasonably certain, but the unreliable character of various microchemical reactions makes the study of the details very difficult.

Observations upon the Morphology of a Species of Osmunda from the Cretaceous Formation, and its Relation to Existing Species: Professor D. P. Penhallow, McGill University.

In material from the Cretaceous of Skidegate Inlet, Queen Charlotte Islands, collected by Dr. C. F. Newcombe in 1895 and 1897, there were several fragments of plants representing the stipe, rhizome, fertile and sterile pinnules of a fern. Although not in actual connection, these fragments proved, upon examination, to belong to the same genus and undoubtedly

to the same species which has, therefore, been designated as *Osmundites skidegatensis*. From the material now at hand it is possible to effect a complete restoration of the plant with the exception of details relating to the sporangia, but as these structures differ but little in the Osmundaceæ, it would be possible to complete even this detail in a general way, from existing types. A close comparison with existing representatives of this family shows that it approaches the type of *Todea* in certain details of the phloem structure, as also in the absence of an endodermal layer. In all other respects it closely approaches the type of *Osmunda,* to which it is no doubt most closely related. A fact of very special interest is derived from a close comparison of the relative dimensions of the various structural regions and organs, from which it appears that the fossil must have been at least eight times larger than the modern *Osmundas* such as *O. claytoniana* or *O. cinnamomea,* and, with respect to the individual stem, much larger than *Todea barbara.* The general conclusions which these facts seem to indicate are that *Osmundites* represents a transitional form from which, or from a point near which, divergent lines of development arose, leading to the type of *Todea* on the one hand, and to the type of *Osmunda* on the other. It would also seem that *Osmundites* must have represented a period when the individual members of the family were much larger that at present, the existing species indicating, in their small size and diminished numbers, a tendency toward obliteration of this branch. The paper was fully illustrated by lantern slides.

Ecological Conditions of Plant Growth in the Isle of Pines: Professor W. W. Rowlee, Cornell University.

The Isle of Pines has an area of nearly a thousand square miles. It is about one fifth as large as Jamaica and is as large as all the other islands that immediately surround Cuba would be if put together. It lies about thirty miles south of western Cuba, from which it is separated by a very shallow archipelago, the islands of which are small coral keys covered, for the most part, with a dense growth of mangrove. The island lies on the southern verge of the plateau, the northern part of which is the island of Cuba.

The northern and larger part of the island consists of a rolling table-land, in its highest parts scarcely more than 300 feet above tide. The most conspicuous physiographic features of this part of the island are the mountains which rise abruptly in isolated masses to a height of from 500 to 1,600 feet. The principal ones are Sierra Canada, Sierra Caballos and Sierra Casas.

The flora of the island, taken as a whole, is xerophytic in its tendency. Upon the mountains this tendency manifests itself most strikingly. Not only do plants grow upon the naked rocks, but many plants, such as bromelias, orchids and aroids, grow upon the trees and shrubs without any direct connection with terra firma. Among the trees here were species of *Clusia, Ficus* and *Cecropia,* as well as others not identified. On the rocks mingled with them were *Plumerias, Bilbergias, Fourcroyas* and cacti in great profusion. Palms were abundant, particularly on the perpendicular faces of the mountains, and were kept in constant motion by the sea breeze.

The flora of the mountains is very different from that of the plains, and strangely enough the pines are confined to the plains. To the ecologist the mountains afford a most interesting study, and there also remains much to be done before anything like a satisfactory list of the species can be written. The island is completely surrounded by a mangrove zone.

Here as elsewhere it is the plant that reclaims the sea. The ocean current and tide sweep through it, carrying the débris from other lands, and the roots of the mangrove retain it. It is practically a pure growth, as few other plants can exist under such conditions. It is limited inland by tide-water and is the favorite abode of the *cayman*, many of which may be seen from a ship in passing. Immediately behind the mangrove zone comes a belt of palms, among which are small savannahs in which grasses and sedges form a sward. Nowhere else in the trip were seen such numbers and varieties of palms growing. It reminded one of the palms of the Amazon. Some were palmetto-like, others bore pinnate leaves. Very few were in flower at the time of our visit (January) and the time at our disposal did not warrant our trying to identify them.

Three regions not sharply delimited may be distinguished in the interior of the northern part of the island, the savannahs, the pine lands and the stream banks.

The Malpais River is so named from the wet savannahs in the central part of the island through which it flows. The savannahs also extend to the uplands and have steadily increased in size as the natives have burned them over to improve the pasturage. Besides sedges and grasses there are many other herbaceous plants, especially species of Leguminosæ. They make up a thick sward. All show by their form and the texture and vesture of their leaves a decidedly xerophytic adaptation. Scattered everywhere through the savannahs are arborescent palms mostly of the palmetto type. One species with perfectly rotate leaves and fibrous sheathing bases to their petioles was everywhere seen. Its identity has not yet been determined. The sheaths enclosed one another on the stem, and when separated had the appearance of fibrous cornucopias. Thirty to fifty could be taken from one plant.

The pine lands resemble those of our own gulf region. The pine predominates over considerable areas. They are best developed on the higher ground. They have palms mingled with them everywhere, especially in the lower lands. The kinds of pine have been discussed by the writer in another place. There has been heretofore little done upon the study of their affinities, but in general they have been referred to *Pinus cubensis*. The natives distinguish several kinds and select certain ones for construction. In many of them are large black termites' nests. Not only does the termite infest the island, but ordinary ants are present in large numbers and build large mounds in the savannahs and pine lands. They are a serious obstacle to agricultural pursuits and have, beyond doubt, been an important factor in determining the character of the native vegetation.

Finally along the streams the vegetation shows the least xerophytic tendency, and closely approaches the conditions found in humid tropical regions. Several Scitamineæ occur here, also many ferns and orchids. The trees are mostly broad-leaved and large. Palms abound, also shrubs of many kinds. The soil is rich and very porous. If it were not for the overflow in the rainy season, its agricultural value would be very great.

In conclusion it may be said that the island presents the greatest diversity of conditions. The agriculture of the island, although in a primitive condition, shows this. Tomatoes, potatoes and other crops grown in the north grow well, and at the same time oranges, mammey, guava and all sorts of tropical fruits flourish. It may be truly said that here the vegetations of the temperate and tropical zones meet.

Artificial Sea-water: Dr. RODNEY H. TRUE, Department of Agriculture.

Two solutions were tested: (1) A synthetic solution made up with chemically pure chemicals and distilled water, and (2) a solution made by redissolving in a proper volume of distilled water sea salts that had been obtained by carefully evaporating sea water to dryness over a water-bath. The composition of the synthetic solution adopted was the average established by the *Challenger* analyses.

Cladiphora gracilis and *Enteromorpha intestinalis,* together with small scup, silversides and other marine fish and lower animals, were found to live and grow for part of the summer in both solutions. In view of certain unfavorable conditions under which these tests were made, these results make it seem very probable that artificial solutions may be used to replace sea water in some kinds of marine aquarium work.

Notes on the Genus Herpomyces: Professor ROLAND THAXTER, Harvard University.

The morphology and development of *Herpomyces* were described with the aid of diagrams. With the exception of certain species of *Dimeromyces* the genus is the only one among the Laboulbeniaceæ the members of which are parasitic on orthopterous insects, and is of interest from the fact that it adds another to the short list of genera in which the sexual organs are separated on different individuals, which, however, normally develop side by side in pairs corresponding to the spore pairs formed in the ascus. The germinating female spore forms a minute 'primary receptacle,' which gives rise to one or more fertile branches; and the latter, coming in contact with the substratum, form 'secondary receptacles,' which may creep more or less extensively, and, becoming independent of the primary receptacle, after perforating the integument of the host by means of clearly defined short haustoria, produce a variable number of perithecia. The primary receptacle of the male individual is similar to that of the female, and usually produces a variable number of simple antheridia directly; in one instance also producing in addition secondary receptacles as in the female, the perithecia being, however, replaced by tufts of antheridial branches. Although these plants occur on insects (Blattidæ) which are supposed to belong to one of the most ancient types, and are distinctly aberrant when compared with other Laboulbeniaceæ, they do not appear to represent as primitive a type of structure as is found in some other genera, nor do they seem to throw new light on the as yet obscure relationships of the group.

The Contribution of Linnæus and his Students to Phytogeography: Dr. HENRY C. COWLES, University of Chicago.

The path-breaking work of Linnæus in taxonomy is well recognized, but phytogeographers have commonly begun their science with Humboldt. As a matter of fact, Linnæus and his students presented a vast amount of material which should be more fully recognized. In his treatise entitled 'Om Växters Planteriog, grundet på Naturen,' published in the first volume of the transactions of the Royal Swedish Academy in 1739, Linnæus outlines a number of the fundamental principles of phytogeography, citing numerous illustrations. Ideas expressed here, as in his various travels and better-known taxonomic works, were worked over in detail by several of his students, and published in the *Amœnitates Academicæ.* Among the best of these treatises were Biberg's 'Œconomia Naturæ' (1749), Tornander's 'Herbationes Upsalienses' (1753), Hedenberg's 'Stationes Plantarum' (1754), and Åmanu's

'Flora Alpina' (1756). Hedenberg's analysis of plant habitats would be a credit to a modern student, and Åmanu's Alpine studies bring out much of value. A trace of the principle of succession of plant associations is found in Biberg, who pictures the changes on a rock surface from lichens to the forest.

Some Notes on the Bending of the Inflorescence of Daucus Carota: Dr. Henry Kraemer, Philadelphia College of Pharmacy.

It was observed that the bending of the peduncles of *Daucus Carota* at the close of the day was in inverse proportion to the age of the inflorescence, *i. e.*, this bending is most pronounced in peduncles bearing buds and very young flowers, and decreases with the development of the flowers, so that the oldest flowers show little or no bending of the peduncles. Furthermore, all of these stages were observed on a single plant.

An examination of the anatomy of the peduncles in different stages of the development of the inflorescence showed an increase in the development of mechanical tissues associated with the fibrovascular bundles, the amount of thickening and degree of lignification of the walls of the cells increasing with the age of the peduncles and being greatest in the lower portion and least in the upper part of the same peduncle, and entirely wanting in the peduncles of the buds.

Another observation was that on cool nights after cool days during both summer and fall, when the temperature was about 10° to 15° C., there was a marked diminution in the bending of the peduncles, even in the flower buds, the latter being erect in the majority of cases. On the other hand, this bending was most pronounced in the evening of a hot day when the temperature ranged from 27° to 37° C.

These observations, taken in connection with others, tend to show that the bending of the peduncles of *Daucus Carota* is not due to low temperatures, but that it appears to be influenced by the conditions affecting transpiration and is in the nature of a wilting, this being most pronounced in the young peduncles, which are deficient in mechanical tissues and in which transpiration is most active, and at the close of the day during which the conditions for transpiration have been most favorable.

Studies upon the Cytohydrolytic Enzymes Produced by Soft Rot Bacteria: Professor L. R. Jones, University of Vermont.

The account was based upon studies of *Bacillus carotovorus*, although related organisms were used in comparison. The enzyme was secured apart from the living organism by four methods, as follows: (1) By passing culture broths through porcelain filters, thus removing the organisms and leaving the enzyme in solution in the sterile liquid. (2) By heating broth cultures to 55° C. or slightly above. Since 51° is the thermal death point of this organism, sterility was thus secured, whereas the enzyme, although weakened at 58°, was not fully inhibited until about 62° was reached. (3) By adding the proper amounts of either phenol, thymol or formalin. Chloroform did not sterilize. (4) By precipitation with alcohol.

Detailed studies were made with the enzyme secured by the fourth method including the determination of the following points: (*a*) The relative activity of the enzyme as secured by fractional precipitation with increasing amounts of alcohol; (*b*) the relative activity from filtered as compared with unfiltered broths (porcelain filters); (*c*) the relation of composition of broth, and (*d*) of age of culture to enzyme production; (*e*) minimum, optimum and

maximum temperatures for cytohydrolytic action; (*f*) relative activity in the presence of varying amounts of sodium hydrate and of each of the following acids: hydrochloric, acetic, oxalic, formic, citric, malic, tartaric; (*g*) relative activity in the presence of the juices of the host plants of this bacillus (carrot, tomato, etc.); (*h*) relative activity in the presence of the products of growth of the organism. Practically no diastatic action occurred.

The full paper will soon be published.

A New Key to the Phylogeny of the Monocotyledons: Professor E. C. JEFFREY, Harvard University.

Recent extensive investigations of the anatomy of the higher plants, living and fossil, have established beyond question that anatomical features, especially in the case of the larger groups, are even more constant than those presented by the reproductive and floral organs. This being the case, it is not surprising that they should be used to an increasing extent in the elucidation of phylogeny. The intention of the present abstract is to call attention to the fact that there are certain anatomical features of the Monocotyledons which appear to be of considerable phylogenetic value.

It has long been known that the bundles of the aerial stem of the various monocotyledonous orders are of the closed collateral type, while those of rhizomes often present a curious concentric condition, in which the phloem, exactly reversing the arrangement found in the vascular cryptogams, is surrounded completely by xylem. The latter type of bundle has been called by Strasburger amphivasal, to distinguish it from the amphicribral concentric bundle, which is characteristic of the vascular cryptogams.

The author has found that the amphivasal type of concentric bundle is present not only in monocotyledonous rhizomes, but in the nodal regions of the reproductive axis as well. The amphivasal concentric bundles of the reproductive axis make their appearance at a varying distance below the nodes, and usually disappear entirely from the stem after the leaf-traces have passed off. The reproductive axis is consequently divided into a number of distinct phytomeres, which are characterized at their upper ends by the presence of the amphivasal concentric bundles just described. Sometimes in the extreme upper part of the floral axis, where the internodes become shortened, the amphivasal nodal segments of the axis are fused, so that the fibrovascular tissue becomes continuously concentric, just as is ordinarily the case in monocotyledonous rhizomes.

The occurrence of concentric bundles at the nodes of the reproductive axis has been made out by the author, in the Gramineæ (*Zizania, Phleum, Coix, Zea, Calamogrostis, Elymus,* etc.), Cyperaceæ (*Scirpus, Eriophoron, Cladium, Carex,* etc.), Juncaceæ and certain of the lower Liliaceæ. He believes that these facts furnish a valuable additional clue to the phylogeny of the Monocotyledons.

It is a well-established general principle, resulting from the study of the comparative anatomy of living and fossil gymnosperms, equisetales, etc., that ancestral anatomical conditions are extremely apt to persist in the reproductive axis. The occurrence of concentric bundles at the nodes of the reproductive stem in the above groups is consequently, in all probability, to be regarded as an ancestral feature. This view gains force from the fact that in *Potamogeton,* etc., and many grasses, the concentric bundles occur throughout the stem, but only at the nodes. Moreover, in the higher Liliaceæ, the Iridaceæ, the Orchidaceæ, the aroids, the palms and the Scitamineæ, etc., concentric bundles have

entirely disappeared from the nodes of the reproductive axis.

Briefly, the author's hypothesis is that the primitive monocotyledon was a segmented plant, composed of phytomeres, and characterized by the presence of concentric bundles at the nodes. Probably as the result of periodically recurring unfavorable conditions of existence, the primitive segmented type of stem became differentiated into vegetative and reproductive portions of very different structure. The vegetative part of the stem gradually became characterized by tufted leaves and short internodes, resulting finally in the fusion of the nodal segments, containing concentric bundles to form a continuous system. In the reproductive axis of the lower groups of Monocotyledons, on the other hand, the ancestral division of the stem into distinct phytomeres is retained, together with the recurring segments of concentric bundles. In the higher monocotyledons, however, the primitive organization disappears and concentric bundles are no longer found in the reproductive axis.

The hypothesis outlined above is based on the study of a considerable number of facts, and, further, seems to gain force from two considerations. In the first place, it agrees on the whole very well with the data supplied by a study of the floral organs. Secondly, a typical cambium has been found in the reproductive axis and seedlings of some of the lower monocotyledonous orders mentioned above. The latter feature is reserved for subsequent consideration, but it may be pointed out that this discovery lends support to the opinion recently expressed by Queva, in connection with his anatomical studies on the Uvulariaceæ, viz., that the Monocotyledones are derived from the Dicotyledones, or an equivalent stock, by the loss of a cambium and an increase in the number of leaf-traces.

W. F. Ganong,
Secretary.

SCIENTIFIC BOOKS.

Morphogenetische Studien. Als Beitrag zur Methodologie Zoologischer Forschung. By Tad. Gabrowski. Gustav Fischer. 1903.

Gabrowski publishes under the above title a quarto monograph of which the first 24 pages deal with the structure of *Trichoplax adhærens,* 9 pages with the biology of this animal, and 141 pages of general discussion.

In regard to the structure of *Trichoplax* very little that is essentially new is added. The organism is disc-shaped and, as a rule, irregular in outline. It has an outer layer of ciliated ectoderm, and an internal spongy parenchyma. It lacks completely digestive tract, reproductive organs and nervous system. Some of the parenchyma cells, although not differentiated into muscles, are probably contractile, and cause the changes in the shape of the body.

Trichoplax moves slowly over solid bodies by means of the long cilia on its under surface. No food particles of any sort have ever been found in the body, and the author's only suggestion is that the food may be soluble organic matter absorbed from the surrounding water; but this is purely conjectural, and nothing new was discovered as to the probable source of food.

Reproduction is by division into two pieces; the body drawing away in two directions until the connecting part is finally broken. Gabrowski has also seen two, and even three, individuals come together and fuse into a single mass, for which process he suggests the use of the term concrescence—a term that has acquired a very different meaning, and it seems unfortunate to apply it to this process of fusion.

A long discussion of the affinities of *Trichoplax* leads the author nowhere, since no new facts of any significance have been added by his work and the speculation is not particularly illuminating. Even less impressive is the long, heavy discussion of the gastrula theory which is painfully dragged through

37 pages. All the old, threadbare opinions and speculations that have formed the staple of embryological literature for the last twenty-five years are tediously passed in review—only once more to reject the gastrula theory, a conclusion already reached by so many writers that it would be tiresome merely to cite their names.

The germ-layer definition is 'analyzed,' by which is meant more empty surmising. Finally the reader, if he has not long since lost interest in the protracted discussion, is rewarded by a sort of diversion on 'physiological morphology,' where more commonplace and vacuity are in order.

When morphologists, on the slender basis of a few, new, trivial histological details, can trespass on the time of their fellow-workers to the extent of 174 quarto pages of antiquated discussion, it is, indeed, time to fly from such company and seek new fields where the length of a contribution may be expected to bear some relation to the importance of the discoveries. T. H. M.

Biological Laboratory Methods. By P. H. MELL. Pp. xii + 321. New York, The Macmillan Co. 1902.

It is difficult in a brief statement to do justice to the work of Dr. Mell. We may, however, find the task simplified when we realize that a very considerable amount of the space is devoted to the 127 figures, many of large size, almost all of which are taken from the catalogues of dealers in laboratory and microscopic supplies, and in other apparatus more or less pertinent to the needs of the biologist. Indeed, the addition of an appendix containing a list of prices would have rendered the publication of catalogues by these dealers for some time hereafter a work of gratuity.

For the rest of the book—say sixty per cent. —it may be said to contain a detailed account of a large number of photographic and microscopic apparatus and methods for most of which the beginner in biology—for whom the work is intended as a text-book in a strict sense—will scarcely have use. The same may be said of the very numerous directions for the preparation of tissues. It is remarkable in such a text-book, the rationale of which is to enable the beginner to 'build only the foundation' of biological study, that the for him more simple and useful methods of making simple microscopic preparations of fresh tissues are chiefly omitted. But, of course, we are rapidly passing beyond the pitiable simplicity of ante-microtomic days. The young student of nowadays will, with Dr. Mell's book, get an elaborate knowledge of chromatic aberration and numerical apertures. He will then devote himself to a careful and somewhat exhaustive study of microtomes, following which he will address himself to the numerous special methods of killing, hardening, clearing, imbedding and the like, and of photography, bacteriological methods, injection, maceration and polarization in the order named. The student, having mastered these things, will then presumably be ready for the study of biology in the narrower sense, that, namely, of plants and animals themselves. F. E. LLOYD.

Oeuvres Complètes de J.-C. Galissard de Marignac; Hors-série des Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Geneva, Ch. Eggiman et Cie; Paris, Masson et Cie, et al. Vol. II. 4to. Pp. 840.

This volume completes the admirably executed reprint of the researches of the great Swiss chemist, the first volume of which was reviewed by SCIENCE on January 16, 1903 (p. 111). The final volume contains Marignac's most important memoirs on atomic weights, a number of interesting and clear-sighted papers concerning various rare elements, several critiques and many papers upon physico-chemical subjects, including his important researches on the specific heats of solutions. At the end is a list of the atomic weights determined by Marignac, in parallel column with the 'International' values of 1903—a comparison which redounds greatly to Marignac's credit. A classified index covering both volumes completes the collection, leaving nothing to be desired. The editor, M. E. Ador, is much to be congratulated on the success of his work.

THEODORE WILLIAM RICHARDS.

SOCIETIES AND ACADEMIES.

AMERICAN MATHEMATICAL SOCIETY.

A REGULAR meeting of the American Mathematical Society was held at Columbia University on Saturday, February 28, 1903, extending through the usual morning and afternoon sessions. Thirty-one members were in attendance; fourteen papers were presented. The president of the society, Professor Thomas S. Fiske, occupied the chair, being relieved at the afternoon session by Vice-President Professor W. F. Osgood. The council announced the election of the following persons to membership in the society: Professor F. H. Bailey, Massachusetts Institute of Technology; Mr. A. T. Bell, High School, Reynolds, Ill.; Professor F. P. Brackett, Pomona College, Claremont, Cal.; Mr. W. E. Breckinridge, Morris High School, New York, N. Y.; Professor Ellen L. Burrell, Wellesley College; Miss E. B. Cowley, Vassar College; Professor E. E. De Cou, University of Oregon; Mr. F. D. Frazer, University of Oregon; Professor J. Willard Gibbs, Yale University; Dr. C. N. Haskins, Massachusetts Institute of Technology; Mr. A. C. Lunn, University of Chicago; Mr. C. L. E. Moore, Cornell University; Mr. F. G. Reynolds, College of the City of New York; Mr. C. E. Stromquist, Yale University; Professor W. E. Taylor, Syracuse University; Mr. Charles Van Orstrand, U. S. Geological Survey. Five applications for admission to the society were received.

Professor E. W. Brown was reelected a member of the editorial board of the *Transactions* for a term of three years. The office of assistant secretary of the society, vacated by the appointment of Dr. Edward Kasner to the editorial staff of the *Transactions*, was abolished.

It was decided to hold the summer meeting of the society at Massachusetts Institute of Technology during the week beginning August 31. A colloquium will this year be held in connection with the summer meeting. Courses of three to six lectures will be given as follows: By Professor E. B. Van Vleck, 'Selected topics in the theory of continued fractions and divergent series'; by Professor F. S. Woods, 'The connectivity of non-euclidean space'; by Professor H. S. White, subject to be announced.

The following papers were read at the February meeting:

L. P. EISENHART: 'Congruences of conics.'

EMORY MCCLINTOCK: 'The logarithm as a direct function.'

H. P. MANNING: 'Non-euclidean geometry of nets of circles.'

C. E. STROMQUIST: 'A generalization of the length integral.'

EDWARD KASNER: 'Three notes on projective geometry.'

W. B. FORD: 'A theorem concerning the functions of two or more complex variables.'

W. F. OSGOOD: 'The integral as the limit of a sum, and a theorem of Duhamel.'

E. R. HEDRICK: 'The integral curves of a partial differential equation.'

E. B. VAN VLECK: 'On an extension of the 1894 memoir of Stieltjes.'

A. S. GALE: 'On a generalization of a set of associated minimum surfaces.'

G. A. MILLER: 'A fundamental theorem with respect to transitive substitution groups.'

E. W. BROWN: 'On the derivatives of the lunar coordinates with respect to the elements.'

CHARLOTTE A. SCOTT: 'On the fundamental theorem of projective geometry.'

ALFRED LOEWY: 'Ueber die Reducibilität der reelen Gruppen linearer homogener Substitutionen.'

After the meeting many of the members present dined and passed the evening together.

The next meeting of the society will be held in New York on April 25. The Chicago Section will meet at Northwestern University, Evanston, Ill., on April 11. The San Francisco Section will hold a meeting early in May.

F. N. COLE,
Secretary.

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

SEVERAL New York biologists met at the home of Professor Graham Lusk, on January 19, 1903, to consider the advisability of organizing a society for experimental biology and medicine. This project was originally suggested by Dr. S. J. Meltzer. Those present at this meeting were unanimously in favor

of the plan suggested. The temporary chairman, Professor Frederic S. Lee, appointed Drs. Meltzer, Lusk and Gies a committee on constitution and by-laws.

On the 25th of February the meeting for permanent organization was held in the Laboratory of Physiological Chemistry of Columbia University. A constitution was adopted, officers were elected and a program of experimental demonstrations was successfully carried out.

The objects of 'The Society for Experimental Biology and Medicine' are, as indicated in the constitution, 'the cultivation of the experimental method of investigation in the sciences of animal biology and medicine.' "Any person who has accomplished a meritorious original investigation in biology or medicine by the experimental method shall be eligible to membership." "Every member shall be expected to conduct an experimental investigation, and give public notice of it, at least once in two years. Non-compliance with this requirement carries with it forfeiture of membership." "The program of each meeting shall consist in brief presentations of the essential points of experimental investigations in biology and medicine or allied natural sciences, preferably of *demonstrations* of actual experiments." The meetings will be held in suitable laboratories.

The officers elected to serve for the ensuing term are:

President—Dr. S. J. Meltzer.
Vice-President—Dr. Wm. H. Park.
Secretary—Dr. William J. Gies.
Librarian—Dr. Graham Lusk.
Treasurer—Dr. Gary N. Calkins.

The following demonstrations were made:

An experiment to show the difference in effect between the simple cutting of the cervical sympathetic and the removal of the superior ganglion: S. J. MELTZER.

Dr. Meltzer presented a rabbit in which the cervical sympathetic had been cut on one side, and the superior ganglion had been removed on the other side. Both pupils were of the same size. About two hours before the demonstration one hind leg was tightly constricted and 1 c.c. adrenalin injected into it (peripheral to the ligature). On removal of the ligature the pupil on the side from which the ganglion had been excised became greatly dilated, while the pupil on the other side remained unaffected.

Differentiation of monkey blood from human blood by the precipitin serum test: JAMES EWING.

The serum used by Dr. Ewing in this demonstration was obtained from a chicken which had received five injections each of 10 c.c. of human placental blood. This serum proved to be much more selective than the ordinary humanized rabbit serum. The chicken serum in various dilutions up to 1–100 was added to specimens of human and monkey serum in dilutions also of 1–100. It produced turbidities in all the specimens of human blood, but failed entirely to affect the monkey blood. Finally, the chicken serum was added in a dilution 1–5 to specimens of both human and monkey blood. In the human blood a milky ring formed instantly at the line of junction of the test serum with the human serum, and a flocculent precipitate formed in fifteen minutes, while in the monkey serum no change whatever could be observed.

An improved cage for metabolism experiments: WILLIAM J. GIES.

A cage specially designed for experiments on dogs was shown. The parts are so adjusted as to favor the collection and separation of feces, urine and hair. The improvements consist mainly of mechanical devices suggested by experimental experiences of the past few years in metabolism work, all of which are designed to insure quantitative accuracy as well as comparative convenience in the collection of excreta.

Properties of 'Bence Jones's body': WILLIAM J. GIES.

Through the kindness of Dr. Meltzer a patient's urine containing this substance had been placed at our disposal for chemical study. Some of the results of this investigation were presented and various properties of the body demonstrated. Special attention was drawn to a test of Boston's new method of detecting 'Bence Jones's body' in the urine.

WILLIAM J. GIES,
Secretary.

NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

The regular meeting of the section was held January 26, in conjunction with the American Ethnological Association, Professor Thorndike presiding. The first paper was presented by Dr. Maurice Fishberg, 'The Ancient Semites and the Modern Jews.' The somatic characteristics of the ancient and the modern Semites were discussed in detail, the purest representatives of the latter being the Arabian Bedouins. Their anthropological type is distinctly African. The bas-reliefs of the ancient Semites, as represented on the Assyrian and Egyptian monuments, are of the same type. The modern Jews are, on the other hand, a distinctly Asiatic type physically; they are brachycephalic—cephalic index 82 with less than five per cent. of heads having an index of 75 or less. Their head form shows very little variability, but one important feature is that in countries where the non-Jewish population is round-headed the Jews are also round-headed. In Caucasia their cephalic index is 87; in eastern Europe, where the cephalic index of the non-Jews ranges between 80 and 84, that of the Jews is about the same. In Africa, among the long-headed Gentile population, the Jews are also dolichocephalic. The same is observed to be the case with stature. The Jews are taller in countries where the general population is tall. The type of the Jew is dark, but 12 per cent. of pure-blood types, having fair hair and blue eyes, are to be found. The nose of the modern Jew is not as frequently hooked as is generally supposed. Statistics show that only 12 per cent. are of this variety. The only characteristic which often betrays a Jew is the 'Ghetto eye.' But such Jews who have lived outside of the pale of the Ghetto for a few generations do not present this phenomenon. Physically there are two types of Jews—one derived from Asia, commonly called *Ashkenasim,* and constituting more than 90 per cent. of the modern Jewry. It has no relation at all with the second type, of African origin, commonly referred to as *Sephardim.* These, constituting less than 10 per cent. of the Jews, alone are more or less related to the ancient Semites, although they have not everywhere preserved themselves as pure as in Africa. Besides these there are to be discerned other subtypes, in which Teutonic, Slavonic and Mongolian blood appears most prominent. From the standpoint of physical anthropology, the view that all the modern Jews are descendants of Abraham, Isaac and Jacob, can not be seriously considered. The only thing which binds the modern Jews together is their religion. In blood there is no more relation between the Jews than there is between the people who profess the protestant, methodist or unitarian religion.

Mr. H. H. St. Clair, 2d, then read a paper, 'Investigations among the Comanche and Ute Indians.' The investigations were made during the summer of 1902 upon the Comanches on the Kiowa-Comanche Reservation, Oklahoma, and the Utes of the Uintah Reservation, Utah. Both tribes belong to the great Shoshonean family. These tribes have a very loose social organization and no elaborate religious ceremonial. There are no calendar-records nor any traces of heraldry among the Comanches. The designs painted on rawhide bags or woven in beads have no meaning as with the Shoshones, but are merely ornamental, and there is lack of the symbolic conversationalism found among such people as the Arapahoes and Sioux. In their stories the coyote figures as the most frequent character representing the fool and schemer. There are striking similarities between the Shoshone and Nahuatl languages of Mexico, each using the same grammatical processes in its pronoun, noun, preposition and verb, and the order of words and structure of the sentence being practically the same in both.

James E. Lough,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THERMODYNAMICS OF HEAT-ENGINES.

To the Editor of Science: In undertaking to express to you, and through your columns to Dr. Thurston, my appreciation of his very generous review of my 'Thermodynamics of Heat-engines,' will you allow me to call at-

tention to one fundamental point in my position which the latter failed to grasp upon first reading.

Dr. Thurston quotes me in the following words: "The much-discussed 'Second Law of Thermodynamics' takes the form: 'The entropy of the world tends to a maximum and the temperature to a minimum.' It is, however, pointed out, etc."

These words are correctly quoted (page 35), but their significance has been directly reversed by omission of the context. The statement of the second law just quoted is given by me as itself a quotation of its heretofore accepted form, for direct contrast with my own statement of it, which will be found (on pages 25 and 35, with elaboration and explanation in the intervening pages) in words which may be condensed into the following, for present purposes:

"That while any given quantity of energy tends, so long as it exists without transformation, to fall in intensity, and never the reverse, *yet* the secondary form of energy into which that quantity may at any time find itself transformed possesses a degree of intensity which is *entirely independent of that of the original quantity*, and which is *the maximum permitted by circumstance.* In other words, energy tends downward in intensity during untransformed existence and upward during transformation."

This necessarily denies *in toto* the doctrine of the dissipation of energy. It affirms, on the contrary, that as much exaltation of energy is constantly going on as there is of depression of energy. In short, the total fund of intensity or availability of the energy of the universe is as constant as is the universe's total fund of mass, or as is its total fund of the product of the two, energy itself.

The availability of the energy of the solar system is, of course, being steadily dissipated. But progress in astronomy has generations ago passed the point when observations confined to the solar system suffice for the establishment of fundamental principles such as these.

The new statement of the second law takes on especial importance as being, if true, one link in the chain of evidence confirming the unity of the universe, the modern idea of which was so interestingly referred to recently by Professor Newcomb. The doctrine of the dissipation of energy necessarily excluded any possibility either of the universe being infinite and eternal in its extent or of its being one with the solar system. The new statement not only is consistent with those ideas, but it is implied by or implies them, whichever end of the sequence the thinker may prefer to regard as the natural origin.

SIDNEY A. REEVE.

THE JUDITH RIVER BEDS.

THE reader of Professor Osborn's recent note in SCIENCE on the 'Age of the Typical Judith River Beds' would be led to infer that I had either denied or questioned the Upper Cretaceous age of these beds. Since this note places me in an entirely false position on this question, I wish to offer the following brief remarks by way of explanation.

1. I have never even so much as questioned the Upper Cretaceous age of the Judith River beds. The point I raised was as to their stratigraphic position within the Upper Cretaceous relative to the Pierre.

2. Osborn's statement that since Cope, Cross, White and Dana have referred these beds to the Upper Cretaceous, they therefore overlie the Pierre is unwarranted, since these authorities and American geologists generally have heretofore included everything from the Dakota to the Laramie in the Upper Cretaceous. Would Professor Osborn place the Dakota, Benton and Niobrara above the Pierre because those same authorities have referred these deposits to the Upper Cretaceous?

3. All who are familiar with the literature on this subject know that the Judith River beds have been referred to different ages by Hayden, Meek, Leidy, Cope, Marsh, White, Stanton, Cross, Lesquereux, Newberry and others, varying from Lower Tertiary on the one hand, to Lower Cretaceous or Upper Jurassic (Wealden) on the other, and that, therefore, Osborn has *not* 'abundant authority for the statement that among geologists of the United States there has never been any ques-

tion as to the Laramie or Upper Cretaceous age of the typical Judith River Beds.'

4. Since Hayden's stratigraphical observations near the mouth of Little Rocky Mountain Creek do not harmonize with the paleontological correlations of Drs. White and Stanton at the mouth of the Judith River, and since no one has ever revisited the first locality and reversed Hayden's determinations by a reexamination of the stratigraphy, I believe the exact stratigraphic position of the Judith River beds remains unsettled and that it is premature to assert that 'the true Judith River beds certainly overlie the Ft. Pierre and are of more recent age,' although this is now very generally believed and may eventually prove to be the case.

J. B. Hatcher.

BOTANICAL NOTES.

VEGETABLE GALLS.

These curious growths, which result from the action of two organisms, have not received the attention of botanists which they deserve. That they develop because of the presence of some insect, or as a consequence of the sting or puncture of another insect, does not make them less vegetable in nature. A prickly gall on a rose leaf is a rose structure as truly as the rose fruit is, and its growth and development are as properly the objects of study by the botanist as are the growth and development of any other plant structures.

Mr. Edward Connold, an English botanist, has recently brought out a most interesting book on 'Vegetable Galls,' which must help to direct the attention of botanists to this neglected field. By means of fine half-tone reproductions of photographs he shows more than one hundred galls and their variations, and to these he has added descriptions which bring out quite methodically their structural characteristics, and their relation to the causal parasites. In treating the subject the author groups galls into: (1) Root galls, (2) stem galls, (3) leaf galls and (4) flower and fruit galls. Of the first he illustrates six kinds by as many plates. Among the thirty-one plates of stem galls perhaps the most suggestive are numbers 23 and 24, which show galls on the twigs and stems of *Salix cinerea* caused by the larvæ of *Agromyza schineri*, and which so closely resemble the early stages of the 'diamonds' on the 'diamond willow' of the Great Plains as to suggest similarity of origin. Of leaf galls there are no less than sixty-three plates, representing a great number of different forms much like those found on leaves in this country. Twelve plates are given to the illustration of the galls on flowers and fruits, including two in which the galls are the familiar 'plum pockets' due to the presence of the minute fungus *Exoascus insititiæ*.

A similar work should be undertaken in this country. Mr. Connold has set a good example, showing us how to illustrate as well as how to treat the subject. No doubt the text is capable of improvement, and yet we should not object to a work in which the text was patterned directly after that found in the English book. Here is an open field for some of our active young botanists to enter.

POPULARIZING THE STUDY OF FUNGI.

Any book which increases popular interest in any department of botany should be welcomed by scientific men, even though the treatment may not be quite like that in works designed to be used by students and professors in the colleges and universities. No doubt those of us who belong to the latter class are quite too much inclined to measure the value of every book by our own needs and standards. We commend the book which meets our wants and which is so written that it seems to be addressed to us or our students, and too often we deem of little value the book in which we find nothing new for ourselves, although it may appeal directly to many other people who know less about the subject. That there are some popular books which are simply atrocious is true, and the present writer has been obliged to denounce them in strong terms, and yet it is an open question whether even the worst of these are wholly bad. With their crude drawings and barbaric coloring, they may appeal to certain classes of untrained minds much more than the ele-

gantly drawn figures to be found in some of our best works. We must not forget that wood-cuts precede steel plates, that 'chromos' are antecedent to the appreciation of good oils and water colors, and that gaudy adornment is the forerunner of that finer and nicer ornamentation that prefers quietness of form and color.

All this is apropos of a book on the fungi —really on the toadstools and mushrooms— prepared by an enthusiastic amateur fungologist, Captain Charles McIlvaine, with the title 'One Thousand American Fungi.' We are told that a score of years ago, while the author was living in the mountains of West Virginia, he became interested in the luxuriant growths of fungi which he saw in his rides through the dense forests. Beginning with a gastronomic interest (which in fact still dominates his work), he has widened his field of interest so as to take in much of what we are pleased to regard as scientific. Gradually the idea of preparing a book took form, and the result is a large octavo volume of more than seven hundred pages, and including a couple of hundred illustrations, many being colored plates or half-tone reproductions of excellent photographs. In order to secure the information he desired in regard to the edible qualities of fungi, he had personally to test "hundreds of species about which mycologists have either written nothing or have followed one another in giving erroneous information." He naïvely refers to the frequent 'unpleasant results' following such personal tests, but in the end he felt repaid by "the discovery of many delicacies among the more than seven hundred edible varieties" which he found. Such work constitutes real investigation. It is laboratory work of a special kind, but while its purpose is the discovery of gastronomic facts, they must be included in the mass of knowledge and experience which we call science. While appealing primarily to the mycophagist, this book will be found useful to the mycologist also.

MARINE LABORATORY BOTANY FOR 1903.

THE annual announcements for the season of 1903 of three water-side laboratories are at hand. The first of these is that of the Marine Biological Laboratory at Woods Holl, Mass. Here, as in former years, the botanical work will be under the general direction of Professor Bradley Moore Davis, of the University of Chicago. The work may be under supervision or without supervision. Under the former, courses are offered in morphology, physiology, cytology, ecology, and the morphology and taxonomy of the thallophytes. For these the usual fees are charged. Investigators who wish to take up lines of work without supervision may be accorded the privilege free of expense by making application to Dr. Davis and complying with certain requirements. The session begins July 1 and ends August 12.

The Minnesota Seaside Station, at Port Renfrew, on Vancouver's Island, will open about the middle of July and close about the first of September. As in former years, the station is to be under the direction of Professor Conway MacMillan, of the University of Minnesota, Minneapolis. The party is to leave Minneapolis *viâ* the Canadian Pacific Railway 'about July 15,' and return to Minneapolis 'about September 1, making two stops, one at Glacier, the other at Laggan.' "Classes in elementary and advanced botany will be formed for high-school teachers and undergraduate college students." Advanced workers will find many problems awaiting their independent investigation.

The Ohio State University Lake Laboratory will be open again at Sandusky, and, as heretofore, will include work in several lines of botany. This year there are offered general botany (the study of type forms, from the lowest to the highest orders), ecology, systematic botany, and the morphology and taxonomy of algæ and fungi. As the work is all under Professor Kellerman, this is a sufficient guarantee of its high quality. Instruction begins June 29 and closes August 7, but the laboratory does not close until somewhat later in the summer.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

ITHACA, N. Y., WATER-SUPPLIES.

A 'Committee of Ten' appointed by the Business Men's Association of Ithaca and other prominent citizens has been engaged, since the epidemic of typhoid appeared in that city and in anticipation of the taking over of the water-works system by the municipality, in exploring for artesian supplies. There are many flowing wells in the district eastward of Ithaca, especially at Freeville, some ten miles away, and on the upper levels of that section, near the city. In the city of Ithaca are two such wells, the one, which has been flowing for a number of years and, as stated by the proprietor, with increasing volume, was found when measured by the committee to deliver 403,000 gallons per day. The other is supplying the Ithaca Salt Works with water at the rate of between 600,000 and 700,000 gallons. The committee has bored one new, a flowing well, and is now engaged in boring others to depths of from about two hundred to three hundred feet, reaching strata of water-bearing gravels overlaid with heavy beds of clay and with water under pressures of considerable magnitude. The members of the committee state that there is no question that an absolutely pure, germ-free water may be obtained in ample amount to supply the city and with a large surplus.

The analysis of the water, as given by Chamot, is as follows:

	Parts per million
Free ammonia	0.480
Albuminoid ammonia	0.005
Nitrogen as nitrites	none
Nitrogen as nitrates	trace
Oxygen consumed	0.644
Chlorine as chlorides	61.640
Total solid residue	304.000
Loss of solids on ignition	78.000

"The different portions taken gave from 0 to 13 colonies of bacteria per cubic centimeter. No objectionable species were detected.

"From the chemical analysis it is be concluded that the water is free from any present contamination and is therefore a good, safe drinking water; while from the bacteriological standpoint it would be considered a well of exceptional purity."

The committee includes Professor R. S. Tarr, professor of geology, Cornell University, who has long been familiar as a specialist with the geology of the region, Mr. Edgar Kay, of the College of Civil Engineering, an expert in hydraulic and water-works engineering, Mr. M. E. Calkins, president of the Cayuga Lake Cement Co. and the Ithaca Salt Works, a business man of extensive experience in the exploration of the salt beds of the state and an expert in matters relating to deep wells and the location of water-bearing deposits, Mr. R. H. Thurston, director of Sibley College, is consulting member relative to machinery, Mr. F. M. Rites, formerly of the Westinghouse Company, an experienced mechanic, inventor and designer, and several business men more or less familiar with the conditions determining the location of deep wells at Ithaca and its neighborhood. Two are members of the City Council. The chairman of the committee is Judge Almy, now Surrogate, and the treasurer is Mr. C. D. Bouton, ex-mayor of Ithaca.

It is the plan of the committee to ascertain precisely what are the possibilities and the practicable ways of securing for the city of Ithaca such water as is above referred to. The people of Ithaca are practically unanimous in their determination to secure such a supply if possible. The indications thus far are thought to be that a gravity supply may be had from the high lands east of Ithaca or that now well-known and probably unlimited artesian supplies beneath the city itself may be availed of by pumping. Very possibly the latter may be taken as a temporary resource while exploiting the Freeville district for a permanent gravity system. Meantime, filtration will serve, if delay occurs, until pure, clear, soft and germ-free artesian water is thus obtained.

Throughout the late epidemic, an ample supply of this water has been had and freely used, with other fine spring waters. The University has supplied this water on the campus and, where called for, to students.

R. H. Thurston.

March 12, 1903.

PRESENTATION OF A BUST TO PROFESSOR CHAMBERLIN.

PROFESSOR J. C. BRANNER, of Stanford University, proposed at the meeting of the American Association for the Advancement of Science, in 1901, to present a bust of Professor T. C. Chamberlin to the University of Chicago in recognition of his eminent services to the science of geology. A number of other geologists joined Professor Branner, and the bust was presented with appropriate ceremonies on February 7. The principal address was made by Professor Van Hise, who gave an account of Professor Chamberlin's investigations, in the course of which he said:

"Professor Chamberlin has the speculative power of the Greeks in seeing lines along which a solution may lie; but, unlike the Greeks, is not content when a possible solution has been suggested. After the modern scientific man has devised various possible solutions he has before him the far more difficult task of determining the *true* solution. The profound difference between the ancient speculative philosopher about science, and the modern scientific man, is that the one requires only a brilliant constructive intellect and reasoning power; while the other requires with this a capacity for patient, laborious, consecutive, constructive work running through years, exhaustive collection of material, observational work in the field, experimental work in the laboratory, verification and reverification, sifting, testing, judging, and thus finding out, not what *may be* the truth, but what *is* the truth. It seems to me that Professor Chamberlin's eminent success as a scientist lies in this two-fold power. With speculative ability only, a man is untrustworthy and erratic. With the power of steady drudgery only, he is mediocre. Combine the two, and he is a scientist of the first rank."

Addresses were also made by President Harper, Professor Salisbury and Dr. Bain, and Professor Chamberlin responded as follows:

"It is quite impossible for me to express in any fitting way the feelings that arise in response to this very unusual honor. I was surprised when the request—put in the jocular form of command—to sit to Mr. Taft, came to me. I have not ceased to be surprised ever since, and I am more surprised to-day at the terms that have been used in this presentation. If there have been two things that have been supreme objects of aspiration to me on the professional side, they are the desire to develop and present some truths that shall live as long as man shall have need of truths; and the other, that I may touch by some small measure of inspiration young minds with longer lives and with better preparation for the work of the future than are granted to me. My students and my colleagues know that as a result of my studies I make no limited estimate or forecast of the future of the earth and of its possibilities, of the future of man and his great development. I see no early and final winter; I see no portending calamity to this earth. I see a possibility, a probability, almost a certainty, of millions of years of human endurance on the earth; and, in view of that fact, when I recognize that every truth lives and works every day and every hour, by night and by day, I feel that, even though a small truth be brought forth and sent upon its mission, in the long ages in which it has to work it can not but do great things. And when I think of the influences which young men and young women, coming to the active spheres of life with greater advantages than those of us of the past have had, will exert in the fulness of time; when I realize that they will be able to transmit to others, and these to others, and to others still, the measure of thought that comes to them—though I realize that all this must lose its personal relationship to its author and must be submerged in the common flood of influences that will commingle with it as time goes on—yet, it is a pleasant and inspiring thought that these, too, shall work and that the truth sown shall be fruitful as long as man walks upon the earth. It is especially grateful to me to hear to-day from my colleagues in science, from those whose judgment I must respect, such expressions regarding the scientific investigations which I have been permitted to make. It is also especially gratifying to hear the expressions of

appreciation of those whom I have been privileged to lead in the early paths of truth. I can not express all that I would. I hope that you will take my wish in place of my inability."

THE SMITHSONIAN INSTITUTION.

The board of regents of the Smithsonian Institution held an adjourned meeting on the morning of March 12, all the members being present with the exception of Senator Cullom, President Angell, Mr. Olney and Dr. White.

The chancellor, the chief justice of the United States, reported on behalf of the committee appointed at the last meeting of the board, to consider the whole subject of defining the powers and duties of the executive committee. Two meetings of the committee had been held, but two members, Senator Cullom and Representative Dinsmore, had been unable to attend, and the other members of the committee, considering the importance of the subject entrusted to their consideration, would not take the responsibility of making a report unless the matter could be considered by the full committee. The chief justice expressed the opinion, however, that the committee realized that under present arrangements too little time was afforded the regents for the consideration and discussion of the important matters entrusted to their care. He thought that there should be more frequent meetings of the board of regents, and regular and stated meetings of the executive committee. Senator Platt and Representative Adams of the committee agreed with him in this, and Representative Adams offered a resolution providing for three meetings of the board of regents each year: One, the annual meeting in January, for the transaction of the usual routine business, and the others—one on the sixth of December, and one on the Tuesday following the first Monday in March—for the discussion of the affairs of the institution, and for a free interchange of views among the members. This resolution was passed unanimously.

In the discussion the opinion was very generally expressed that the executive committee also should hold more frequent meetings, and that they should have regular and stated meetings for the discussion of the affairs of the institution, but the members thought that the executive committee should provide for its own meetings, and that this was not a matter calling for the action of the board.

The members also very generally expressed the opinion that the board was not ready to define the powers and duties of the executive committee—that this demanded careful consideration and an examination of the organization, and of the United States statutes referring to it. It was therefore moved that the committee be continued and that it should make a report upon the subject at the next meeting of the board which will be on December 6, unless this should fall upon a Sunday, in which case the meeting will be on Monday following. This resolution was passed by the board, and it is understood that in accordance with the suggestion of Judge Gray the secretary will prepare for the use of the board, a pamphlet containing references to all the United States statutes referring to the institution and its allied bureaus.

The subject of the new building for the National Museum came up for consideration. Congress has appropriated the sum of three millions and a half dollars for a new building for the National Museum, and the making of contracts, etc., for the erection of the building has been placed by congress in the hands of Mr. Bernard R. Green. Action was taken looking to the beginning of immediate work upon the new museum building, authorizing the secretary with the advice and consent of the chancellor, and the chairman of the executive committee, to arrange with Mr. Bernard R. Green in reference to carrying out the act of congress.

The question of the management of the government bureaus in charge of the Smithsonian Institution and the policy of the institution towards these bureaus then came up for discussion. Dr. Bell recommended a return to the policy of the first secretary, Professor Henry, and urged the importance of granting autonomy to each bureau. He stated that it was the duty of the regents to consider

carefully, how the usefulness and value of the Smithsonian Institution and its allied bureaus could be improved, and offered the following resolutions:

The secretary shall nominate, and by and with the advice and consent of the board of regents, shall appoint the heads of the various bureaus supported by Congress under the direction of the Smithsonian Institution—*to wit*—the National Museum, the Bureau of American Ethnology, the National Zoological Park, the Bureau of International Exchanges, and the Astrophysical Observatory.

The secretary shall have power to fill up all vacancies that may happen in these offices during the intervals between meetings of the board, by granting commissions which shall expire at the next meeting of the board of regents.

The head of each bureau shall nominate, and by and with the advice and consent of the secretary, shall appoint the subordinates in the bureau under his charge.

The heads of the bureaus shall be termed directors; and the board of regents hereby creates the offices of director of the National Museum, director of the Bureau of American Ethnology, director of the National Zoological Park, director of the Bureau of International Exchanges and director of the Astrophysical Observatory, and instructs the secretary to fill these offices by temporary appointment to expire at the next meeting of the board, when nominations shall be presented for confirmation by the board.

There was no time for adequate discussion of these resolutions and it was believed by all the members that the subject was of too great importance to be passed upon at once by the board. Judge Gray thought that the resolutions should be examined and reported upon by a committee, before asking the board for a decision, and suggested that they might be referred to the committee having under consideration the definition of the powers and duties of the executive committee, for a report. Dr. Bell thereupon withdrew his motion, and moved to refer the resolutions to the committee as suggested by Judge Gray, and this motion was adopted by the board.

The question of the disposition of the remains of James Smithson, the founder of the Smithsonian Institution, then came up for consideration. It will be remembered that the regents had been notified that the body of James Smithson would have to be removed from his grave, in order to make room for a quarry, and that the regents had decided that the remains should be transferred from the cemetery in Genoa, Italy, where they now rest, to another cemetery in the same city. Dr. Bell offered to have the remains removed to this country at his expense, if the regents would take charge of them upon their arrival, and in view of this proposition he moved a reconsideration of the decision of the board relating to the disposition of the body. The regents seemed to be very favorably impressed with the proposition, and in view of the fact that there was no immediate necessity for the removal of the grave, and that no time remained for discussion of the matter, the resolution was allowed to lie over to be acted upon at the next meeting of the board in December. The meeting then adjourned.

SCIENTIFIC NOTES AND NEWS.

THE National Academy of Sciences will hold its annual stated meeting at Washington beginning on Tuesday, April 17.

THE American Philosophical Society will hold at Philadelphia a general meeting on April 2, 3 and 4. The preliminary program contains the titles of thirty-one papers, including one by President Daniel C. Gilman, on 'The Carnegie Institution during the first year of its development,' and one by Dr. W. H. Welch on 'The objects and aims of the Rockefeller Institute for Medical Research.' The sessions will be held in the hall of the society beginning in the morning at 10:30 and in the afternoon at 2. Luncheon will be served to members on each day; there will be a reception to members and ladies accompanying them on Thursday evening, and visiting members will be the guests of resident members on Friday evening.

PRESIDENT ROOSEVELT has appointed the following as a commission to report to him on the organization, needs, and present condition of government work, with a view to including under the Department of Commerce bureaus not assigned to that department by congress:

Charles D. Walcott, Department of the Interior; Brigadier-General William Crozier, War Department; Rear-Admiral Francis T. Bowles, Navy Department; Gifford Pinchot, Department of Agriculture; James R. Garfield, Department of Commerce and Labor.

The Carnegie Institution, on the recommendation of the advisory committee on geophysics, has appropriated $6,000 to be expended under the direction of Dr. T. C. Chamberlin, of the University of Chicago, in research relative to fundamental problems in geology. The investigation will consist of a joint mathematical, astronomical, physical, chemical and geological inquiry into certain phases of the earth problems that lie in the common domain of these sciences. Dr. F. R. Moulton, of the department of astronomy of the University of Chicago; Professor C. S. Slichter, of the department of mathematics of the University of Wisconsin; Professor L. M. Hoskins, of the engineering department of Leland Stanford University; Professor Julius Stieglitz, of the department of chemistry, and Mr. Lunn, of the department of mathematics of the University of Chicago, will participate in the inquiry.

The French Academy of Moral and Political Sciences has elected Professor E. Caird, master of Balliol College, Oxford, a corresponding member of the philosophic section.

M. Bigourdan, astronomer at the Paris Observatory, has been appointed a member of the Bureau of Longitude in the room of the late M. Faye.

President Roosevelt has appointed a board of visitors to the Naval Academy for the coming year as follows: Dr. Henry S. Pritchett, Massachusetts Institute of Technology; Professor H. C. Ellis, of Texas; Mr. Lewis Nixon, of New York; Rear-Admiral George Brown, U.S.N., retired, of Indiana; Captain A. T. Mahan, U.S.N., retired, of New York; Lieutenant R. M. Thompson, U.S.N., retired, of New Jersey; and Mr. John R. Procter, of Kentucky, civil service commissioner.

The Carnegie Institution has made an appropriation to Dr. J. E. Duerden to assist him in his investigations on the morphology of recent and fossil corals. The studies were commenced while Dr. Duerden was curator of the museum, Jamaica, B. W. I., and have been continued at the Johns Hopkins University and the American Museum of Natural History, New York. The principal results thus far are contained in a series of four papers published in the *Annals and Magazine of Natural History*, and in a *Memoir* of the National Academy of Sciences just issued.

Dr. Alexander Graham Bell entertained the board of managers of the National Geographic Society, of which he is president, at dinner on the evening of March 14. It is reported that Mr. Ziegler has invited the National Geographic Society to send a representative without cost to the society on the Arctic expedition that he is planning.

Professor William Beebe, of the mathematical department of Yale University, is at present in Italy.

Professor Barula, the zoologist of the Baron Toll expedition, who left the expedition's yacht *Saria* in May with three others to engage in scientific research in New Siberia, has arrived at Irkutsk, eastern Siberia.

Professor R. H. Thurston, director of Sibley College, Cornell University, gave a lecture before the New York Electrical Society on March 18, the subject being 'The Steam-turbine to date.'

Congress has passed a bill appropriating $125 per month during her lifetime as a pension to Mrs. Emily Lawrence Reed, widow of the late Major Walter Reed, U.S.A., whose important investigations on yellow fever at Havana are well known.

The death is announced of M. Alexis Rousset, the explorer, at Cape Lopez, in the Gulf of Guinea. He was returning from an expedition in the Shari region, where he had discovered and mapped a shorter route through the Tafa region, between Lake Chad and the Congo basin.

Stanford University has secured the library of the late Mr. Konrad, chief hydraulic engineer of the Netherlands.

THE German emperor has approved of a plan for founding an institute for advanced medical education in Berlin as a memorial to the late Empress Frederick.

SENATOR WM. A. CLARK, of Montana, has contributed $250 for the furtherance of the investigations being carried on by the University of Montana Biological Station at Flathead Lake, under the direction of Professor Morton J. Elrod. This is his fifth contribution for this purpose.

THE consul-general for Mexico in Liverpool has received official notification that the Mexican government proposes to give an annual grant of money to the Liverpool School of Tropical Medicine, in whose operations from its formation they have taken a deep interest.

THE London Epidemiological Society held a meeting on February 25 for the discussion of the possible spread of yellow fever to Asia by way of the Panama canal. The discussion was opened by Dr. Patrick Manson, medical adviser to the Colonial Office. A committee was appointed to cooperate with American societies in drawing the attention of the governments of Great Britain and the United States to the question.

PROFESSOR RUSSELL H. CHITTENDEN, director of the Sheffield Scientific School of Yale University, has arranged the Thirty-Seventh Annual Course of Sheffield Lectures, which are now being delivered on Friday evenings, at 8 P.M. Following is the list of lectures, with their subjects:

'Mont Pelée and the Tragedy of Martinique': Professor ANGELO HEILPRIN, of the Academy of Sciences, Philadelphia.

'Storms and Weather Phenomena': Professor WILLIS L. MOORE, Chief of the U. S. Weather Bureau, Washington.

'Peary's Progress to the Pole': Mr. HERBERT L. BRIDGMAN, of Brooklyn, N. Y.

'Our Isthmian Canal': General HENRY L. ABBOTT, of the U. S. Army, Retired, Cambridge.

'Household Art in Japan': Professor EDWARD S. MORSE, of Salem.

'Recent Astronomical Photography': Mr. GEORGE W. RITCHEY, of Chicago University and the Yerkes Observatory.

'Modern Methods and Results of Exploration for Dinosaurs': Professor HENRY F. OSBORN, of Columbia University.

'The Discovery of the Use of the Arteries; or Experiment vs. Subtlety in Biology': Professor JOHN G. CURTIS, of Columbia University.

'The Medicine-Man': Professor ALBERT G. KELLER, of Yale University.

'Professional Codes of Ethics': Professor ROSSITER W. RAYMOND, Secretary of the American Institute of Mining Engineers.

'The Land of Ophir': Professor JOHN HAYS HAMMOND, of the Sheffield Scientific School.

THE following cablegram has been sent from Great Britain to the daily papers: Lord Lister has communicated to the Royal Society a paper by Dr. Allan Macfadyen, director of the Jenner Institute of Preventive Medicine, setting forth a prophylactic and curative treatment for typhoid fever. Dr. Macfadyen found that by crushing the microscopic cells of the typhoid bacillus in liquid air the cellular juices can be obtained apart from the living organism and that these juices are highly toxic. By injecting them in small, repeated doses into living animal its blood serum is rendered powerfully anti-toxic and bactericidal; that is to say, it becomes an antidote alike to living typhoid bacteria and to the poison that may be extracted therefrom. Dr. Macfadyen explains the application of the serum to animals and details his various experiments which showed that the serum is a curative of typhoid as well as a protective against infection. The Jenner Institute is now investigating the juices of other bacteria. If its experiments prove, as is expected, that bacterial juices in general react upon the animal organism in the same way as on the living bacteria which produce them, the fact will profoundly influence medical speculation and practice. Regarding the crushing of bacteria the question naturally arises, by what unimaginable accuracy of grinding can these infinitesimal organisms be broken so as to release their intercellular toxins. The crushing of the bacilli is done in liquid air because when thus frozen hard they become brittle and, notwithstanding their almost inconceivable minuteness, can be completely broken up by trituration and will under no subsequent conditions show a sign of bacterial growth.

UNIVERSITY AND EDUCATIONAL NEWS.

It is said that the suits over the will of Dr. Thomas W. Evans are now substantially settled, and the city of Philadelphia will receive a sum approximating $4,000,000 for the 'Thomas W. Evans Museum and Institute Society.' This institution is for 'the teaching of dentistry and for the display of his royal presents and personal effects.'

Mr. John D. Rockefeller has offered to duplicate money raised by Acadia College, in Wolfville, N. S., up to $100,000 before January 1, 1908.

Mrs. John Markoe, of Philadelphia, has given $5,000 to Harvard University to establish a scholarship in memory of her son James Markoe of the class of '89.

President Pritchett and other representatives of the Massachusetts Institute of Technology appeared before the committee on ways and means of the Massachusetts House of Representatives on March 11, in support of a bill designed to give the corporation of the institute power either to build over the whole or the part of the western two thirds of the block bounded by Boylston, Berkeley, Marlboro and Clarendon streets, or to sell it. President Pritchett indicated that the institute might be moved to new buildings on land owned by it near Jamaica Pond, Boston.

The physical laboratory of the University of Michigan will be extended this summer by the addition of a large lecture-room seating 400 and several other rooms for laboratory work. The top floor, which has hitherto been devoted to bacteriology, will be vacated by that department and will be added to the department of physics.

On Saturday, February 21, the University of Montana dedicated, with appropriate ceremonies, two new buildings, one a gymnasium and the other a woman's hall. The two buildings cost $40,000, but were not completed within the appropriation. An appropriation of $5,000 has been made by the legislature for their completion according to the original plans.

At Yale University Dr. Andrew D. White has been appointed Dodge lecturer on the responsibilities of citizenship, and Sir Frederick Pollock, of London, Storrs lecturer in the Law School.

Dr. George B. Halsted, late of the University of Texas, has been elected to the chair of mathematics at St. John's College, Annapolis, Md.

At Columbia University Albert P. Wills, A.B. (Tufts), Ph.D. (Clark), lately associate in applied mathematics and physics at Bryn Mawr College, has been appointed instructor in mechanics and mathematical physics; and Bergen Davis, A.M., Tyndall fellow of Columbia University, has been appointed tutor in physics.

Dr. J. E. Ives, instructor of physics in the University of Cincinnati, will leave his present position to go with the American de Forest Wireless Telegraph Company of New York City on the first of April next. To begin with Dr. Ives will have charge of the experiments with wireless telegraphy on moving trains and afterwards he will take up a series of investigations connected with the development of wireless telegraphy along commercial lines.

Dr. E. B. Brown, professor of Arabic at Cambridge University and fellow of Pembroke College, has been offered the mastership of the college in succession to the late Sir George Stokes.

Mr. Joseph Larmor, fellow of St. John's College, Cambridge University, has been elected Lucasian professor of mathematics in succession to the late Sir George Gabriel Stokes. Mr. Larmor is secretary of the Royal Society and is well known for his contributions to mathematics, his most important work being 'Ether and Matter.' The Lucasian professorship was founded in 1663 by Mr. Henry Lucas, who had been M.P. for the University. The first professor was Dr. Isaac Barrow, who resigned in 1669, Isaac Newton being elected to succeed him.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 27, 1903.

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AMERICAN SOCIETY OF ZOOLOGISTS. I.

THE American Morphological Society and the Zoologists of the Central and Western States met in Washington, D. C., in the Medical School Building of the Columbian University, December 30, 1902, and held joint sessions during this and the two succeeding days. A very large number of the members of the societies were in attendance, and an unusually long and interesting program was enjoyed.

During the meeting final action was taken that brought the members of the two above-mentioned societies together under the name of the American Society of Zoologists, with an eastern and a central branch. The constitution adopted looks toward meetings of the society once in three years, to be held alternately in the territories of the two branches. The time and place of the annual meeting of each branch is to be determined by its executive committee.

During the afternoon of the first day a joint session was held with Section F of the American Association for the Advancement of Science, at which papers from the programs of each of the societies were given. Owing to the large number of papers to be presented, further combination did not seem expedient.

The following are brief abstracts of the papers that were presented:

The Atlantic Palolo: Alfred G. Mayer, Museum of the Brooklyn Institute of Arts and Sciences.

The 'Atlantic Palolo' is *Eunice fucata* Ehlers. It is found at the Dry Tortugas, Florida, and lives within disintegrating coral rock or coquina from below low tide level to a depth of at least six fathoms. Its breeding habits are closely similar to those of the well known Pacific Palolo worm (*Eunice viridis*).

The Atlantic Palolo swarms at the surface before sunrise within three days of the day of the last quarter of the moon, between June 29 and July 28. The posterior sexually mature end of the worm breaks away from the anterior end, and swims backwards and upwards to the surface, where it continues to swim backward with great rapidity until about the time of sunrise, when it contracts, casting the genital products out into the water. The anterior part of the worm remains below in the coral rock, and takes no part in the swarm. The worm requires at least two years to attain sexual maturity. There are 57 per cent. of males and 43 per cent. of females. Only sexually mature worms cast off their posterior ends at the time of the swarm. The immature worms are about twelve times as numerous as the mature.

The shock produced by cracking the coral rock acts as a stimulus to produce the drama of the breeding-swarm before the normal date of the swarm. Eggs obtained in this manner are immature and can not be fertilized, even twelve hours before the time of the normal swarm. All of the eggs mature simultaneously within the swimming worms at the time of the normal swarm.

The eggs float in the water, are fertilized and begin to segment soon after extrusion from the worm. The segmentation is total and unequal, the gastrula is formed by epibole, and the larva is telotrochal. The young larvæ swim near the surface, but sink to the bottom upon attaining four pairs of setigerous lobes. The posterior segment of the larva bears a pair of dorsal as well as a pair of ventral cirri. Only the ventral pair of cirri persist in the fully developed worm.

An Aberrant Rotatorian: T. H. Montgomery, Jr., University of Pennsylvania. (Read by title.)

Dimorphic Queens in an American Ant (*Lasius latipes* Walsh): W. M. Wheeler and J. F. McClendon, University of Texas. (Published in the *Biological Bulletin,* Vol. IV., No. 4, March 1903, pp. 149–163, 3 Figs.)

A colony of *Lasius latipes* observed near Rockford, Illinois, during the nuptial flight (September 17, 1902) was found to contain numerous virgin queens of two different types. One of these (the 'β-female') was the fulvous red, remarkably hairy and flat-legged type, with very short tarsi, that has been heretofore regarded as *the* female of *latipes.* The other ('α-female') was dark brown, less hairy, with much less flattened legs and decidedly longer tarsi. The α-type was also found in material from two nests of *latipes* collected in a very different locality (Colebrook, Connecticut) during August, 1901. No transitions between the two types were observed in any of the nests. The following hypotheses may be advanced to account for the occurrence of the two different queens in the same colony: (1) One of these may be supposed to be the female of a species parasitic on *latipes.* (2) The β-female may represent merely a diseased condition of the α-female. (3) The α-form, in pilosity and structure, is so clearly intermediate between the β-form and the female of *Lasius claviger* Roger as to sug-

gest the possibility of its being a hybrid between *latipes* (β-female) and *claviger* ♂. (4) The α- and β-females represent a new case of dimorphism *sensu stricto* in *L. latipes*. Of these four hypotheses the first and second may be rejected as too improbable to be entertained. The true meaning of the two forms of queens is probably to be sought in the direction of hybridism or of dimorphism *sensu stricto*. Only further observation and experiment can enable us to decide between these interesting alternatives.

Septal Sequence in Corals: J. E. DUERDEN, University of North Carolina.

An account was given of the manner of appearance of the septa in the West Indian coral, *Siderastraea radians* (Pallas), the post-larval development of which has been followed for four months. The results were summarized as follows:

1. The six members of the first cycle of entosepta appear simultaneously, shortly after fixation of the larva, situated within the entocœles of the first cycle of mesenteries.

2. The members of the temporary second cycle, consisting of six exosepta, are developed shortly after the primary cycle of entosepta, within the primary exocœles. The six septa arise simultaneously, or in bilateral pairs in a dorso-ventral order. Later they become bifurcated peripherally, either by the direct extension of the original septum or by the production of separate fragments which subsequently fuse. The bifurcations also appear in a dorso-ventral order.

3. The six members of the permanent second cycle of entosepta arise within the entocœles of the second cycle mesenteries, after these have made their appearance. The two right and left dorsal septa appear first, then the two middle members, and, at a much later period, the two ventral, thus exhibiting a decided dorso-ventrality. In the end they become equal and fuse with the central parts of the second cycle of exosepta previously developed, which now lose their individuality.

4. The twelve members of the temporary third cycle are situated within the exocœles between the primary and secondary pairs of mesenteries, and represent the bifurcated extensions of the six primary exosepta. The original second cycle exosepta thus become the third exocœlic cycle, their place having been taken by the new second cycle of entosepta (law of substitution).

5. The later development of the septa in buds proves that a new third cycle of septa arises in a similar manner, on the appearance of the third cycle mesenteries. New entosepta appear within the entocœles of the third cycle mesenteries, and the bifurcations of the twelve third cycle exosepta become the twenty-four exosepta of the fourth cycle.

6. Exosepta thus appear at each stage in the growth of the corallum, alternating in position and corresponding in number with the entosepta. They never become entosepta, but always constitute the outermost cycle; only the entosepta have any ordinal significance. The adult radial symmetry of the septa is secondary, being derived from structures which appear bilaterally in a dorso-ventral order.

The various stages in development were illustrated by a series of wax models prepared at the American Museum of Natural History, New York.

Iridescent Feathers: R. M. STRONG, Haverford College.

Iridescent feathers from the sides of the neck of the common 'homer' pigeon appear green when the sum of the angles of incidence and reflection is less than 90°, and purple when the sum is more than 90° but less than 140°. The iridescence is

produced by a peculiar form of barbules. There are no attenuated portions, and the individual barbules overlay one another like shingles.

The iridescence is confined to the distal exposed portion of the feather; the same barb may have iridescent barbules distally, and non-iridescent barbules proximally.

The iridescent barbules have much more pigment than the non-iridescent, and this pigment is in the form of spherical granules of melanin, which fill cavities enclosed by a thin transparent layer of keratin. The non-iridescent barbules have the usual rod-shaped pigment granules characteristic of ordinary feathers; these are irregularly distributed in the keratin of the barbule and are often fused more or less completely into small masses.

The spherical pigment granules lying next to the transparent horn layer produce a dispersion of incident light, and the unaided eye receives a mixture of great numbers of the spectra thus formed.

On Anamniote Embryos of the Chick: Frank Rattray Lillie, Hull Zoological Laboratory of the University of Chicago.

The experiments described in this paper consisted, first, in the destruction of the head fold of the amnion between the thirty-third and forty-sixth hours of incubation, with a heated needle; second, a similar operation on the tail-fold of the amnion, immediately after its appearance. If the head fold were completely destroyed without injury to the embryo, the development might proceed up to the age of at least five days in normal manner, except for the complete absence of the amnion back to the hind limbs. In such cases the embryo lay naked on the surface of the blastoderm, to which it was attached in the same manner as a shark's embryo by a very broad somatic and splanchnic umbilicus.

The main conclusions were:

1. The lateral folds of the amnion are in part dependent on the formation of the head fold. In the absence of the latter they are neither so high nor so long as usual, and they do not grow around the embryo. The lateral folds of the amnion must have the support of the head fold to climb up, so to speak, around the body of the embryo.

2. The tail fold of the amnion has only a limited independent capacity of growth; in the absence of the head and lateral folds it does not extend even as far forward as normal.

3. Similarly the head and lateral folds of the amnion have a limited capacity for growth; their backward extension is not simply checked by the advancing tail fold; for, in the absence of the tail fold, these end with a free border in front of the hind limbs.

4. The absence of the amnion has, at least for a time, only a limited effect on the development of the allantois.

5. Inasmuch as the embryo may develop quite normally to the stage of five days without the amnion, it is obvious that the functional significance of the latter must be slight during this period. It yet remains to be determined how far the embryo may develop without the amnion. Certainly there is no good reason for assuming that five days is the limit.

6. There is a certain relation of interdependence between the formation of the amnion and the body wall. In the absence of normal formation of the lateral folds of the amnion, the closure of the somatopleure to form the body wall proceeds more slowly than usual.

The Newly Hatched Larva of Argulus megalops: Chas. B. Wilson, Westfield, Mass., State Normal School.

The most recent classification of the Copepods divides them into three classes:

A. The free-living copepods, Gnathostomata.

B. The parasitic copepods, Siphonostomata.

C. The Branchiura or Argulidæ, also parasitic.

The normal development of the copepods, viz., of the Gnathostomata, is well known to every teacher of zoology, and all have become familiar with the nauplius, metanauplius and cyclops stages in their life history. But the development of the Siphonostomata is still very imperfectly known, and while agreeing in many species with that of the free-living forms, there are frequent modifications resulting from parasitic habits.

The development of the third group, the Argulidæ, has rested until recently upon the study of a single European species, *A. foliaceus,* parasitic upon fresh-water fishes.

But the Argulidæ are found in greater abundance in North and South America and in Africa than in Europe, and are fairly well divided between fresh-water and marine forms.

A recent study of four American species shows that two of them, *A. americanus* and *A. catostomi,* the former a fresh-water species and the latter occurring in both fresh and brackish water, agree almost exactly with *A. foliaceus* in development.

But the life history of the other two species, one, *A. stizostethii,* a fresh-water form, and the other, *A. megalops,* which is marine, is quite different. In both these species the newly hatched larva is almost exactly like the adult. There is no narrowing of the body posteriorly, the abdomen being fully as wide as the thorax and of the same shape as in the adult.

The carapace is somewhat shortened, but even when fully developed it is very meager. The number and arrangement of the appendages are exactly the same as they will always continue.

The form and function of these appendages are also the same, with the single exception of the first maxillipeds, and even here, while the form changes, the function remains constant from the beginning. There is no trace of a temporary locomotor apparatus of any sort or description, as in all other copepod larvæ. We have here, therefore, practically no metamorphosis at all, but a copepod life history which is virtually a direct development, and there is a marked resemblance to the life history of certain orders amongst the insects, such as the Orthoptera, etc.

The Arrangement of the Segmental Muscles in the Geophilidæ, and its Bearing upon the Double Nature of the Segment in the Hexapoda and Chilopoda: L. B. WALTON, Kenyon College.

The arrangement of the dorsal lateral longitudinal muscles in the Geophilidæ corresponds to the division of the segment into an anterior and posterior somite. This, considered in connection with the presence of homologous areas in *Scolopendrella, Campodea, Japyx, Forficula,* etc., together with other evidence, notably the development of the pterygodum (tegula) and wing of the mesothorax in Lepidoptera, the double cross commissures in the embryonic stages of Hexapoda and Chilopoda (as well as Crustacea and Arachnida), the two pairs of metathoracic tracheal openings in *Japyx,* etc., presents a strong case for regarding the segment in the Hexapoda and Chilopoda as composed of two somites, for which the terms *protosomite* and *deutosomite* are proposed.

The 'microthorax' to which Verhoeff has recently called attention as a fourth thoracic segment anterior to the prothorax (Dermaptera) can not be homologized, as he suggests, with the segment bearing the

poison claws in Chilopoda, inasmuch as this segment is composed of a protosomite and deutosomite, the former being homologous with the microthorax (see Geophilidæ). Furthermore, a protosomite homodynamous with the 'microthorax' is present in the Dermaptera on the mesothoracic and metathoracic, as well as on the abdominal, segments. Consequently there is evidence for considering that not only is the thorax in Hexapoda composed of six somites, but that each typical segment in the Hexapoda and Chilopoda (Crustacea and Arachnida?) is composed of two coalesced somites.

The Vertebrate Stomach: J. S. Kingsley, Tufts College.

It is usually believed, since the liver in *Amphioxus* directly follows the gill slit region, that the vertebrate stomach and œsophagus were primitively included in the respiratory region. In the embryos of the vertebrates, however, the anlage of the liver follows as closely the last gill slit as it does in *Amphioxus,* and the stomach and gullet are developed, not from the pharyngeal region, but by rapid growth of the short intermediate region. Hence the stomach in the vertebrate is a new formation without its counterpart in the lower chordates.

The Occurrence of Echinoderm Larvæ with Transverse Ciliated Bands: Caswell Grave, Johns Hopkins University. (To be published in the *Biological Bulletin.*)

Serial Order of Segments in the Fore-brain of Three- and Four-week Human Embryos; Comparisons with Lower Forms: Susanna Phelps Gage, Ithaca, N. Y. (With demonstrations from a series of wax models.)

A three-week human embryo from the collection of Dr. Mall, of Johns Hopkins University, and shown by him and Dr. Bardeen to have two slight anomalies, presents, in the regions of the fore-brain in which the eye and olfactory region are well defined, a third peculiarity. The remnant of the neuropore, the original cephalic opening of the fore-brain, is unusually conspicuous and consists of a thickened union of the epithelium of skin and brain wall. Here arises a furrow extending toward each eye. The conclusion was reached that this point represents approximately the cephalic end of the original neural plate and that as a corollary, by following the original edge of the neural plate, the olfactory region is morphologically caudad of the eye.

A finely preserved and entirely normal human embryo of four weeks prepared by Dr. Buxton, of the Cornell Medical School, gives a similar model, except that the neuropore does not show a thickening. Many other mammalian brains of this stage give similar results.

In a series of chick brains the neuropore was traced to the fifth day, when it was shown to become the recessus opticus.

Summarizing the results of studies in the earlier stages of chick, *Amblystoma* and mouse—the earliest total fold or segment of the fore-brain to appear is the hypophyseal at the cephalic tip of the neural plate; with growth and curving forward of the fore-brain, the eye, second in serial order with relation to the edge of the neural plate, appears; as the eye becomes constricted off the olfactory furrow of the brain appears, entirely dorsal, as shown by His and again (with reference to the edge of the neural plate) following the eye in serial order; next comes the diencephal. From the caudal portion of this original olfactory region arise the folds characteristic of the cerebrum, and from the one furrow of the diencephal the three shown by Minot arise.

Until certain difficult homologies are made in the hypophyseal region of the

brain I hesitate to write a numerical series for the total folds or segments of the fore-brain, but with regard to the crucial point in the investigation, the series and the models seem to show conclusively that the eye and its lens are morphologically cephalad of the olfactory region of the brain and of the nasal epithelium.

A Preliminary Account of Studies on the Japanese Frilled Shark, Chlamydoselachus: BASHFORD DEAN, Columbia University.

In view of the archaic features in the adult, he noted as significant in the development of this form the great depth of the zone of yolk nuclei, the absence of external gills, the more nearly terminal position of the anus, the relatively smaller size of the head, the enormous spiracular cleft and the almost typically finfold type of limb. *Chlamydoselachus* has specialized in the line of producing large eggs, the largest indeed among recent animals, ostrich hardly excepted; that it was, however, until recently an egg-depositing shark is apparent from the character of the horn-like capsule (with rudimentary tendriliform processes) which the egg still retains.

The Ependymal Grooves in the Roof of the Diencephalon of Vertebrates: PORTER EDWARD SARGENT.

A cross-section of the brain of any of the lower vertebrates in the region of the posterior commissure reveals a characteristic ependymal structure of conspicuous form and size. In general this consists of thickened and highly differentiated ependyma forming a groove in the roof of the diencephalon, extending from the posterior commissure cephalad to the ganglia habenulæ. This has been mentioned by but four writers, though it occurs in all vertebrates.

In *Petromyzon* there are two grooves located bilaterally on either side of the median plane. Posteriorly they converge and extend about the posterior commissural flexure and above it and are continued cephalad as two lateral horns of the recessus above the commissure. The specialized ependyma of the grooves is sharply marked off from the ependyma, lining the other portions of the ventricle. Nerve fibers from deep-lying cells pass between the cylindrical ependymal cells, and into the ventricular groove. Here they unite to form Reissner's fiber, the anterior divisions of which lie within the groove.

In the gnathostomes there is but one median groove. In the skates, however, the median groove bifurcates at either end, —evidence of the persistence of the bilateral condition. It is obvious that, phylogenetically, the paired grooves of cyclostomes have been crowded toward the median plane by the development of lateral-lying structures and fused to form the one median groove.

In ganoids, teleosts and amphibians the ependymal groove is strictly median and less conspicuous. It assumes a great variety of forms in the different subgroups. In reptiles it is much as in higher selachians, but reduced in size. In birds it is still further reduced. In mammals it has become an inconspicuous structure, which may still be recognized, however, in the thickened ependyma just cephalad of the posterior commissure.

In general this ependymal structure acts as a support for the constituent elements of the fiber of Reissner, and as an 'anchorage' for the fiber as a whole.

On the Individuality of the Maternal and Paternal Chromosomes in the Development of the Hybrid between Fundulus heteroclitus and Menidia notata: WILLIAM J. MOENKHAUS, University of Indiana.

Fundulus heteroclitus and *Menidia*

notata possess chromosomes which are sufficiently different, morphologically, to be distinguished from each other in the cells of the hybrid between the two species. The former has long, straight chromosomes; the latter short, slightly curved ones.

These two kinds of chromosomes retain their individuality during the development of the hybrids to a late cleavage stage, as far as any attempt was made to follow them. During the first two cleavages each kind remains grouped upon the spindle. During the third cleavage this grouping has largely disappeared and the two kinds of chromosomes occur mingled upon the spindle. During the later cleavage stages this bilateral distribution of the chromosomes has altogether disappeared. The two kinds, however, can readily be distinguished, but thoroughly mingled.

Homologies of Anterior Limb: Theo. Gill, Smithsonian Institution.

The homologization of the anterior member of the terrestrial vertebrates with that of fishes is a problem involving a greater diversity of interpretation than any other structure. By the early anatomists (Cuvier, Owen, Stannius) bones which are now universally regarded as parts of the shoulder girdle were designated as the humerus, radius and ulna.

It is contended that *Polypterus* gives us a key to the problem in question, as was urged by the speaker in 1872, 1878 and 1882.

The diverging branches which inclose the flat cartilage with which the actinosts or basal bones of the fin connect are homologues of the radius and ulna; the tubercular process of the coracoid cartilage with which they articulate is the representative of the humerus; the cartilage between the diverging processes is the stuff from which the carpal bones are developed; and the actinosts represent the metacarpals. The nearly similar conclusions of Emory (1887) and Pollard (1892) were much later and somewhat different.

Pollard found the humerus, radius and ulna in the same parts as the speaker. He went to an extreme, however, in the homologization of the intermediate cartilage or 'mesopterygium.' This, he thought, 'forms probably the intermedium and centralia, and the chief foramen in the ossified part represents the intercarpal foramen.'

Inasmuch as *Polypterus* is a very specialized modern form of the great crossopterygian series, and no extinct representatives of its phylum since Devonian times have been discovered, such an extension of homologies is not legitimate and we must be content to recognize the 'mesopterygium,' as a whole, to be homologous with the carpus. This is in accord with the most recent investigations, but still must be confirmed by paleontology.

Homologies of the Centronucleus: Gary N. Calkins, Columbia University.

The Structure of the Ostracoderms: W. Patten, Dartmouth College.

1. In a newly acquired specimen of *Tremataspis* the post-orbital and the two pairs of marginal openings are completely closed by a small number of close-fitting polygonal plates. In *Cephalaspis* a single pair of very large marginal openings, closed in a similar manner, has been found. A large marginal opening has also been found in *Thyestes*.

2. In the same specimen of *Tremataspis* the dumb-bell-shaped orbital opening is closed by a polished layer of shell, continuous with that of the dorsal shield. Over the lateral ends of the opening the shell is partly broken, but shows clearly that it formed a complete dome-shaped cover to each eye.

3. In *Bothriolepis*, the large median or-

bital plate has a deep pineal pit in its under surface. Two other pits, shallower than the first, are symmetrically placed behind it on the under surface of the semicircular post-orbital plate.

4. The lateral eyes in *Bothriolepis* were placed on short stalks attached to the margin of the orbits by flexible membranes. The lateral end of each stalk was convex, covered with a smooth shell, and could evidently be raised above the orbit or lowered into it.

5. The structure and relations of the 'mental plates' of *Bothriolepis* show that they can not be regarded as either upper or lower jaws of the vertebrate type. If movable at all, they must have moved to and from the median line, bringing their *thickened* and *bent-over* median edges into opposition, like the crushing mandibles of an arthropod.

6. The mouth was very small, round or oval (not a wide transverse opening), located between or just behind the mental plates.

7. The so-called 'semilunars' consist of at least three pieces. Their shape and articulating surfaces show that their posterior margins were freely movable in a *dorso-ventral* direction, like an operculum.

8. Two plates were found supposed to be, one the distal joint, the other a basal plate, of the proximal joint of the pectoral appendage of *Tremataspis*.

9. The basal joint of the appendage in *Bothriolepis* contains a short axial skeleton whose expanded distal end shows indications of several fin-like rays.

10. The gill chamber of *Bothriolepis* is a shallow depression on the dorsal surface of the anterior ventrals.

11. In one specimen the gill chamber was partly covered by a folded membrane and it contained indications of gills. The most exposed gill was a flattened body of elongated form. It appeared to be jointed, with a single broad spur, and a fragmentary filament, near its base. The end directed toward the base of the pectoral appendage terminated in a leaf-like expansion.

These facts confirm the author's view that the Ostracoderms can not be classed with the true fishes.

Maturation Changes in the Egg of an Opisthobranch before Deposition: W. M. Smallwood, Syracuse University.

(To be published in the *Bulletin* of the Museum of Comparative Zoology at Harvard College.)

Experiments on Merogony in Nemertine Eggs, with Reference to Cleavage and Localization: Edmund B. Wilson, Columbia University.

The experiments were performed in order to examine the question of prelocalization of the factors determining the cleavage mosaic in the unsegmented egg. The nemertine egg presents features that allow of its definite orientation from the moment of discharge from the ovary. Egg fragments, obtained before formation of the polar bodies, by shaking the egg to pieces or cutting the eggs individually in various planes with the scalpel, segment exactly like entire eggs of diminished size. Whatever be the plane of section the fragments may, if not too small (one fourth the bulk of the egg or larger), give rise to closed blastulas, which may gastrulate normally and produce dwarf pilidia normal except in size. Isolated blastomeres of the two-cell stage may likewise produce perfect pilidia of half the normal size; isolated one fourth blastomeres may produce dwarf pilidia, never entirely normal, but sometimes very nearly so. In either case the isolated blastomere segments, not like a whole egg, but as if the missing portion of the egg were present. Blastulas

thus arise that are typically open on one side, or in extreme cases form curved or even nearly flat plates; but all these forms may ultimately close, gastrulate and give rise to pilidia, though those arising from the plate-forms appear to be always asymmetrical or otherwise abnormal.

These facts prove that in this egg, which shows a typical spiral mosaic-like cleavage, the form of cleavage is not essential to normal development, since the egg fragment segments as a whole, the isolated blastomere as a fraction, yet both may produce the same result. They prove, further, that the factors determining the cleavage mosaic are not definitely localized in predetermined germ areas before formation of the polar bodies, but become so localized in the period between the beginning of maturation and the completion of the first cleavage. Sections show that during this period a polarized segregation of material takes place. Comparison, especially with the segregation of material occurring at the corresponding period in the eggs of sea-urchins and mollusks, as described by Boveri, Lillie and Conklin, and with the results of Boveri's experiments, leads to the conclusion that this segregation of material is the immediate cause by which the cleavage factors are localized and the form of cleavage determined. Every differential cleavage is probably preceded by analogous segregation of cytoplasmic materials, which not only form an important factor in determining the form of cleavage, but probably are a factor in cell-specification. Cleavage thus plays an important part in differentiation and localization, not as a direct cause, but indirectly as a means of isolation of different materials. The cleavage-mosaic thus becomes a mosaic of such materials and of corresponding developmental tendencies in the individual blastomeres. This mosaic-like character is, however, not due to the preexistence of corresponding areas in the unsegmented egg, but to a progressive process that is essentially epigenetic in character. The primary egg-polarity certainly, and perhaps some other characters, such as bilaterality, preexist in the immature egg, but other cleavage factors are localized by a progressive process in which cytoplasmic movements are a leading factor.

Merogony and Regeneration in Renilla: Edmund B. Wilson, Columbia University.

1. When fertilized eggs of *Renilla* are cut into two or more fragments during the earlier period preceding cleavage, one of the fragments may develop into a dwarf embryo, segmenting at once into eight or ten blastomeres, like a whole egg of diminished size. During the later period, after division of the cleavage nucleus, two or more fragments may develop; but in this case each fragment divides into a smaller number of blastomeres than those produced by an entire egg, the total number being approximately the same as those produced by a whole egg. Cleavage in this egg therefore depends not upon the presence of a certain number of nuclei, but upon the attainment of a critical stage by some other progressive change. The egg fragment may give rise to a planula, and ultimately to a young colony, entirely normal in its structure and proportions, but of diminished size. In this way may be produced dwarf colonies down to about one fourth the bulk of the normal; but, like the full-sized colonies, they do not produce more than a single pair of buds under the conditions in the aquarium. Budding in *Renilla* is, therefore, not dependent upon the amount of material present, but is a process entirely analogous to the formation of organs in the ontogeny of a single individual.

2. As already recorded by Torrey, the young *Renilla* colony exhibits a strongly marked polarity, a new axial polyp being developed after removal of the anterior end, a new peduncle after the removal of the posterior end. After removal of the peduncle posterior to the budding zone it does not ordinarily regenerate a new axial polyp. In a few cases, however, a normal axial polyp was produced at the anterior end of a severed peduncle, and in one case this produced a symmetrical pair of buds in the same position as the primary pair of buds in the normal development. In a single instance a reversal of polarity was obtained, a severed axial polyp regenerating a similar polyp from the basal end, so that a two-headed monster was produced.

3. After oblique section through the budding zone a process of remolding takes place in such a manner as to cause one of the lateral buds to occupy the position formerly occupied by the axial polyp, while the wound entirely heals. A new axis is thus apparently established. At a later period, however, this initial remolding is overcome by a process of regeneration, a new axial polyp developing at the point corresponding to the position of the original one, so that the lateral polyp is again displaced to its original position at the side. This indicates that the persons of the colony are definitely specified and are not interchangeable.

The same result is given by operations in which the peduncle is removed, together with a single small lateral bud. In such cases the remaining bud remains entirely stationary in development, or may even disappear, while a new axial polyp of full size is regenerated from the cut surface. In one case where the lateral bud remained, a corresponding bud was formed on the opposite side so as again to produce the condition of the primitive colony with a single pair of buds.

4. These observations show that the individuality of the buds in *Renilla* has become wholly subordinated to that of the colony, which develops from the egg or regenerates lost parts in essentially the same way as an individual in the ordinary sense.

Notes on the Artificial Reversal of Asymmetry in Alpheus: EDMUND B. WILSON, Columbia University.

As Przribram has described, the removal of the large or hammer-chela in *Alpheus heterochelis* causes the remaining small chela to be transformed at the first or second moult into a hammer-chela of the large type, a chela of the small type being regenerated in place of the large one that has been removed. If after removal of the hammer-chela the nerve of the small chela be severed at the base, this transformation does not take place or is incomplete.

Comparison shows that the small chela of the female conforms closely to the early larval type, while that of the male is more modified in a direction toward the type of the hammer-chela. Since in the young larva both chelæ are alike (Brooks and Herrick) and correspond in type to the female small chela, the latter may be regarded as an embryonic type in a state of arrested development, while the male small chela represents a somewhat more advanced state. In both cases the development of the small chela is held in check by the presence of the large one, the inequality constituting an equilibrium characteristic of the species. Removal of the large chela releases the development of the small one, and at the same time reverses the asymmetry of material. Regeneration then proceeds along the same lines as in the normal development until the adult equilibrium is restored, but in a reversed condition. In this case, therefore, an appa-

rently adaptive regenerative process of high utility to the animal seems to require for its explanation, in the female at least, no special regulative factors that differ from those concerned in the normal development.

Instincts of the Lepidoptera: A. G. MAYER, Museum of the Brooklyn Institute of Arts and Sciences.

On the Color-patterns of Certain Bermuda Fishes: C. L. BRISTOL, New York University.

During the six seasons, June to August, the writer has collected large numbers of living fishes in Bermuda and sent them to the New York Aquarium, where they have been placed on exhibition, and has made many observations upon them in their natural surroundings and in confinement. Taken together they comprise the principal fishes of the West Indies and are fairly representative of the coral-reef fishes. The following conclusions are preliminary only, and may serve only as a starting point for more extended study.

Three factors are correlated with the habits to produce the specific appearance of the various species.

In general, (*a*) the scale of coloration is high, (*b*) the patterns range from simple to compex, and (*c*) the power to change color varies from almost *nil* to an astonishing degree.

1. *Warning Coloration.* — Fishes with high color, simple patterns and little if any color-change are inedible, *i. e.*, disagreeable, or are covered with harsh scales and have sharp fin rays. *E. g.*, the green parrot fish, the squirrel.

2. *Protective Coloration.*—The scale of coloration is not so high; the pattern is complex and the color-change is great. *E. g.*, the 'four-eyed' fish (*Chætodon*), the blue parrot, the hind.

3. Midway between these is a third group in which the three factors are more nearly balanced between the two extremes and in which some offensive or defensive device is added. The color is medium, the pattern is not complex and the range of color change is less than in the second group. This group is illustrated by the angel fish and the surgeons.

Lymphatics of the Lung of Necturus: W. S. MILLER.

The Brain of the Larva of Echinus esculentus: E. W. MACBRIDE, McGill University.

In larvæ of the common British sea-urchin, *Echinus esculentus,* about the twenty-first day after fertilization, there is visible at the extreme front end of the body a shallow pit lined by ectoderm cells which are thicker than those covering the general surface. When sections are made through the pit and examined with a Zeiss apochromatic immersion lens, a very thin layer of nervous fibrils is seen lying at the base of the thickened ectoderm cells. These fibrils are proved to be nervous by the exact similarity in appearance and reaction to osmic acid, between them and the first fibrils which appear in the rudiment of the adult nervous system. The pit does not form a part of the longitudinal ciliated band, and hence can not be compared to the apical thickening observed by Théel* in the larvæ of *Echinocyamus pusillus,* which becomes incorporated with the ciliated band. It does, however, correspond exactly in position with the thickening described by Field† in the larva of *Asterias vulgaris,* and with the apical plate of neuro-epithelium which is one of the character-

* Théel, 'The Development of Echinocyamus pusillus,' *Proc. Royal Soc. Upsala,* 1892.

† Field, 'The Larva of Asterias vulgaris,' *Quart. Journ. Micr. Sc.,* 1891.

istics of the *Tornaria* larva. Field was not able to detect any fibrils associated with the thickening in the larvæ he examined, but in the larva of *Echinus esculentus* the layer of fibrils above described goes on increasing in thickness as growth proceeds, until just before the metamorphosis it is as thick as the cells themselves, and intermixed with the fibrils are a few minute ganglion cells of the type commonly found in the nervous system of echinoderma. The discovery of this brain removes a great difficulty in the way of comparing the larvæ of echinoderma with the *Tornaria* larva.

The Effect of Lithium Chloride on the Development of the Frog's Egg: T. H. MORGAN, Bryn Mawr College.

In 1894 I tried the effect of several solutions on the development of the frog's egg; amongst others, solutions of several halogen salts. The main result was to produce spina bifida embryos. A year later Hertwig extended the same experiment, and in 1896 Gurwitsch also described the effect of a number of substances, including lithium chloride, on the development of the frog's egg. The interpretation given by Gurwitsch of the kind of embryos produced by solutions of this salt did not appear to me to fit in with results that I had obtained in other ways. This led me to take up the subject again. Amongst the different kinds of embryos that I obtained there were some similar to those described by Gurwitsch. I shall not, however, describe here embryos of this sort, nor discuss their interpretation.* Amongst the embryos there was a characteristic kind, different from any that have been yet obtained. It is these that I shall now describe.

* Madame Rondeau-Luzeau has more recently (1902) described the effect of lithium chloride on the frog's egg.

Eggs in the two- and four-cell stages, as well as in early and later segmentation stages, were put into fresh water to which 0.4, 0.5, 0.6 per cent. lithium chloride had been added. The best results were obtained from eggs in the late segmentation stages.

There appears after several days in the eggs in the solutions an invagination on one side of the egg. A little later a crescentic depression or even a complete ring appears high up on the egg, and the whole black hemisphere seems to be sinking into the interior of the egg, with the crescent or ring closing over the top of the egg. At the same time a slate-colored band appears in the region between the first invagination and the ring above. This band is much broader on that side of the egg where the invagination first appeared. Along the middle of this area a darker line runs vertically upward. I may say at once that this line indicates the position of the notochord, and the slate-colored band is a layer of endoderm cells, one cell deep. Beneath it are the two mesoblastic sheets, one on each side of the notochord.

Sections of these eggs show clearly what has taken place. The top of the egg that disappeared into the interior forms inside of the egg the medullary plate, bent double on itself. It lies, therefore, in the middle of the egg. As the whole ectoderm has turned in, the yolk-cells from the sides have been drawn upward, where they form the single layer of cells that cover the slate-colored area. Beneath this lies on each side of the notochord a thick mesoblastic sheet.

The first invagination (archenteron) sinks deep into the egg—possibly it is continued by the yolk cells drawing apart. A narrow archenteron is formed in this way, that bends under the medullary plate in the interior of the egg. The notochord,

that lies just below the dark groove in the middle of the slate-colored area continues into the egg along the dorsal wall of the archenteron.

These embryos do not appear to be able to develop much beyond this stage, although they may remain alive for several days longer in the solutions. The interpretation of this peculiar method of development seems to be as follows: The cells of the upper hemisphere appear to have been prevented from growing down at the sides, and, after the blastopore has been formed, from covering over the lower hemisphere. The medullary plate develops from the inner wall of the cap of ectoderm that has been turned into the interior of the egg. As this upper region sinks in, the surface yolk cells below the equator of the egg are drawn upwards, as has been said, and produce the slate-colored band. They may be supposed to represent, in a general way, the dorsal wall of the archenteron of the normal egg, which is now spread out on the surface of the egg. This comparison needs, however, several important limitations, which I can not enter into here. The rest of the archenteron is represented by the long but very narrow tube leading inwards from the blastopore. Thus the embryo is, in a sense, inverted, the nervous system being in the interior of the egg, and yolk cells almost completely covering the surface. The result is due in all probability, in part, to changes in the osmotic conditions in the egg. I hope soon to describe, with figures, these embryos, as well as other kinds produced in the same solutions.

Experiments on the Origin of the Cleavage Centrosomes: E. G. Conklin, University of Pennsylvania. (To be published in the *Biological Bulletin.*)

On the Erosion of the Shell of Littorina litorea: R. P. Bigelow and Eleanor P. Rathbun.

The investigations of Morse and Ganong have shown that *Littorina litorea* has become established on our coast within the last half century, and Bumpus has made a statistical study of the species, from which important conclusions were drawn as to the changes of type and variability resulting from this change of environment.

Therefore, this species seemed to be a favorable one upon which to make a determination of the present rate and direction of natural selection. But it seemed wise to determine first how far erosion might tend to falsify the results.

Sections of fresh shells were made by the method used in sectioning minerals, and the chief results are given in the following table.

Stage.	Length of Shell.	Estimated Reduction.			Increase of Ventricosity.
	mm.	mm.	Per. cent. of total length.	Per cent. of stage 1.	Per. cent. of total length.
1.	2.87	0	0	0	0
2.	5.0	0.25	5.0	8.7	—
3.	12.5	0.6	4.8	20.9	4
4.	17.0	1.33	7.8	46.3	5–6

The section shows that erosion has begun in stage 1; but, as that is the smallest shell that it was possible to cut, the erosion is assumed to be zero for purpose of comparison with the later stages.

These observations are not sufficiently numerous to have a statistical value, but they are sufficient to show that the factor of erosion must be considered before any conclusions can be drawn from a statistical study of the dimensions of shells of this species, and to suggest that it would be well to make sections and study carefully the extent of erosion before publishing the results of measurements of any other gasteropod shell.

The Variations of Some Acquired Characters: R. P. BIGELOW and ELEANOR P. RATHBUN.

The discussion of the phenomena of coadaptation has emphasized the view that success of the individual in the struggle for existence may depend as much upon favorable individually acquired modifications as upon congenital variations. The present state of any species, then, is the result of selection acting on both (1) variations and (2) modifications, tending to eliminate the unfit of both indiscriminately, and to spare the best fitted. In order to understand the effect of this process upon the species as a whole it is necessary to know the types and the distributions of the deviations of the selected characters.

Much has been done to supply data in regard to congenital variations by workers following the methods perfected by Pearson. But heretofore this new means of investigating biological phenomena has not been employed in the study of acquired modifications. The present investigation was undertaken as a preliminary reconnaissance of this new field.

The material chosen for study is obtained from the records of the first-year students of the Boston Normal School of Gymnastics, kindly furnished to the authors by the director, Miss Amy M. Homans. The records selected are those of women who have completed the first year of training and whose measurements have been recorded at the beginning of the year and at the end of the eight months. The average age is 23.6 years, but nearly half of the students are between 19 and 22 years of age. In most of the series of measurements we were able to obtain from 300 to 330 individual records. The students come from various parts of the country, and upon entering the school are introduced into a new environment, which is very uniform, the gymnastic and mental training being the same for all students.

The questions that the authors have sought to answer are: (1) Is there a change of type, and of what extent? (2) What is the effect of training upon the variability of the group? (3) What is the relation between capacity for modification and initial position in the scale? and (4) what relation exists between amount of modification and length of time of training? The first question has already been answered partially by Beyer, Enebuske, and Wood; the others have not been answered before.

Five series of measurements have been studied, viz., (1) girth of left forearm, (2) lung capacity, (3) mobility of chest, *i. e.*, difference between girth at rest and girth at forced inspiration, (4) strength-weight index, *i. e.*, all the strength tests added together and divided by the weight, and (5) strength of legs.

As was to be expected, the value of the mean of each of these characters was found to have become greater after training. The difference is best expressed in terms of the initial standard deviation. The smallest change was in the girth of the left forearm, amounting to 22.6 per cent. of the standard deviation; the greatest was in the strength of legs, 162.5 per cent. The other changes of type were: lung capacity, 40 per cent.; mobility of chest, 55.5 per cent., and strength-weight index, 101.2 per cent.

The variability was found not to have changed to a sensible degree in three of the series, while in two others there was an increase. For the strength-weight index this was 11.25 per cent. of the original standard deviation, and for the strength of legs, 18.33 per cent. It will be noticed that these two series are the same ones in which the increase of the mean exceeds the magnitude of the standard deviation. The frequency curves are all slightly skew at

first in a positive direction, and after training show a little increase of positive asymmetry, with the exception of the strength-weight index, in which the skewness decreases to nearly perfect symmetry.

The relation between capacity for modification and the initial position in the scale can be determined only after calculation of coefficients of correlation, and for this purpose correlation tables are now being constructed.

The relation between the amount of modification and the length of time of training has been studied in only one series of measurements, that of the strength of legs. The measurements were plotted for every second month, that is, October, December, February, April and June. The magnitude of the mean was found to increase during each succeeding period, rapidly at first and then more and more slowly. The increase amounted during the first period to 20 kilos, during the second to 8.8 kilos, third to 6.4 kilos, and fourth to 0.37 kilos.

Gilman A. Drew,
Secretary (*Eastern Branch*).
University of Maine.

*SOME FUNDAMENTAL DISCOVERIES IN MATHEMATICS.**

The oldest extensive work on mathematics which has been deciphered was written by an Egyptian named Ahmes between 1700 and 2000 B.C. It bears the following title: 'Direction for obtaining a knowledge of all dark things * * * all secrets which are contained in the things,' and claims to be modeled after writings which were then old. The first part is devoted to a table in which every fraction whose numerator is 2 and whose denominator is any odd number from 5 to 99 is resolved into the sum of fractions with unity as a common numerator. The following are examples:

$$\tfrac{2}{5}=\tfrac{1}{3}+\tfrac{1}{15},\ \tfrac{2}{7}=\tfrac{1}{4}+\tfrac{1}{28},\ \tfrac{2}{19}=\tfrac{1}{12}+\tfrac{1}{76}+\tfrac{1}{114}.$$

As this table is constructed according to no general rule, it is probable that it is a collection of results obtained by mathematicians during a long period of years. In fact some of these numbers are found in a mathematical papyrus which is many hundred years older than the work of Ahmes. This table, therefore, furnishes one of the many evidences of the fact that the early development of mathematics is largely based upon experiments. Comprehensive rules and theorems are a much later product.

From a modern point of view it might be said that the theory of arithmetical progression marked the highest point reached by Ahmes in arithmetic. He solves linear algebraic equations involving one unknown and considers the area of a circle equivalent to a square whose side is eight ninths of the diameter. This is equivalent to calling $\pi = 3.1605$, which is a much closer approximation than many later nations employed.* To find the area of an isosceles triangle he multiplied the base by half of one of the equal sides instead of by half the altitude. This inaccuracy seems to be due to the fact that the Egyptians did not know how to extract the square root of a number, and hence they could not find the exact area of such a triangle from its sides.

While the work of Ahmes is of the greatest interest to the mathematical historian, yet it contains few facts of sufficient generality or beauty to be classed among the fundamental discoveries in mathematics. It emphasizes rules rather than thought. In fact, it is practically confined to problems and answers, with the verifications of

* Read before the Science Association of Stanford University, November 5, 1902.

* Cf. I. Kings, ch. 7, v. 23 and II. Chronicles, ch. 4, v. 2.

some of the answers. It appears that the Egyptian did not make any additions to the work of Ahmes for more than a thousand years.

About the seventh century B.C. the Greeks showed such a deep interest in learning that they began to go to foreign countries (especially Egypt) in quest of knowledge. They soon excelled their teachers, and inaugurated a golden period of mathematical progress which has had no equal until recent times. Hence we naturally look to the Greeks for fundamental discoveries whose beauty and generality have engaged the admiration and interest of all who became acquainted with them.

One of the earliest of these is the proof that there are lines which do not have a common measure. Pythagoras observed that it is impossible to divide the side of a square into such a number of equal parts that one of these parts is contained an integral number of times in the diagonal. This fact made a very deep impression on the Greek mind. It is one of those great truths which can never be fully established by experiment, and yet does not rest on postulates or axioms which appear somewhat arbitrary. It thus stands in sharp contrast with the older discovery that the sum of the angles of a plane triangle is equal to two right angles, and deserves to be placed in a higher category of mathematical truths.

A scholium of Euclid's 'Elements,' which is supposed to be due to Proclus, bears evidence of the high regard which the Greeks had for the discovery of the incommensurable or the irrational. It reads as follows: "It is said that the man who first made the theory of the irrational public died in a shipwreck because the unspeakable and invisible should always be kept secret, and that he who by chance first touched and uncovered this symbol of life was removed to the origin of things where the eternal waves wash around him. Such is the reverence in which these men held the theory of the irrational quantities."

Aristotle frequently speaks of the fact that the diagonal of a square whose side is unity is irrational, and in one instance states that otherwise an even number would be equal to an odd number. The meaning of this is made clear by Euclid's proof of the fact that the $\sqrt{2}$, which is the value of the given diagonal, is irrational. Euclid says, in substance, if we assume that $\sqrt{2}=m/n$ a rational number, it follows that $2n^2=m^2$. The fraction m/n may be supposed to be reduced to its lowest terms, and hence at least one of the two numbers m, n must be odd. This, however, makes the equation $2n^2=m^2$ impossible, since the square of an even number is always divisible by 4 and the square of an odd number is odd. By dividing both members of the equation $2n^2=m^2$ by 2 an odd number would be equal to an even number, as Aristotle says. It appears very probable that this elegant proof is due to the Pythagoreans, possibly to Pythagoras himself.

Another fundamental discovery of the Greeks is the use of infinite convergent series. Aristotle observed that the sum of an infinite number of small things may be finite and Archimedes frequently finds the sum of an infinite series in the solution of a problem. For instance, in finding the area of a portion of the parabola he observes that it is equal to the area of a given triangle multiplied by the infinite geometric series $1+\frac{1}{4}+(\frac{1}{4})^2+(\frac{1}{4})^3+\cdots$ and he proves that the sum of this series cannot be greater or less than 4/3. His proof is practically the same as that found in our elementary algebras.

In finding the sum of such infinite series Archimedes answered in a very explicit and definite manner some of the difficult questions raised by Zeno two hundred years

earlier. For instance, Zeno argued that it was impossible to go from one place to another, because one would have to go one half the distance before arriving, but before going half the distance one would have to go one half of this half and so on to infinity. He also argued that Achilles could not overtake a tortoise which moved at one tenth his rate because by the time Achilles reached the place where the tortoise had been when he started the tortoise would have moved some distance ahead, and by the time Achilles reached this spot the tortoise would again have moved some distance ahead, and so on to infinity. These difficulties were completely solved by the Greek mathematicians, and further serious arguments along this line seemed to be based upon ignorance or perversity.

The Greeks were the greatest mathematicians of antiquity and Archimedes was the greatest mathematician among the Greeks. It is, therefore, of especial interest to learn what Archimedes himself regarded as his highest achievements. These consist of several important theorems in regard to the sphere, viz., that the volume of a sphere is two thirds of the volume of the circumscribed cylinder, and the area of the sphere is two thirds of the area of this cylinder. The beauty of these theorems impressed Archimedes so forcibly that he requested that a sphere inscribed in a cylinder should be marked on his tombstone. It is well known that Cicero discovered the grave of Archimedes by means of this inscription.

With the two theorems just mentioned Archimedes classed his closely related theorem, that the area of a zone with one base is equal to that of a circle whose radius is the distance from the base of the zone to its pole. These theorems may have appealed to Archimedes more forcibly on account of the fact that the Pythagoreans used to say that the sphere was the most beautiful of the solids and the circle the most beautiful of the plane figures. There are, however, few theorems in elementary mathematics which establish such unexpected and important facts.

The Greeks studied mathematics for its own sake. They cared little about the practical applications of their results. The following story about Euclid is characteristic: "A youth who had begun to read geometry with Euclid when he had learned the first proposition inquired, 'What do I get by learning those things?' So Euclid called his slave and said, 'Give him three oboli, since he must gain out of what he learns.'" The maxim of the Pythagoreans, 'A figure and step forwards, not a figure to gain three oboli,' is evidence of the same spirit.

In their disinterested search for truth they incidentally made more progress in practical results than was made by other nations who had these results directly in view. The fact that their extensive developments of the conic sections had to wait nearly two thousand years until they found application in the astronomical theories of Kepler, Newton and others is frequently cited as evidence of the importance of developing knowledge for its own sake.

Notwithstanding the remarkable achievements of the ancient Greeks we have to look to a less noted people for one of the most fundamental discoveries of elementary arithmetic, viz., the use of the zero. If we think how cumbersome arithmetic operations become when no use can be made of the zero, it may appear to us marvelous that Europe should have learned the use of this number symbol less than a thousand years ago.

At the last international congress of mathematicians the leading mathematical

historian, Moritz Cantor, expressed the opinion that the use of zero was probably due to the Babylonians 1700 B.C. However, it has not been definitely established that zero was in use any earlier than 400 A.D. About this time it was used in India, and several centuries later the Arabs began to employ it. Through the Arabs its use became known to Europeans during the twelfth century. It was not generally adopted in Europe until several centuries later, notwithstanding its great advantages. For a considerable time there were two parties among the European educators—one party, known as the algorists, favored the adoption of the Hindu system of notation (falsely called Arabic) with its position values, while the other, known as the abacists, favored the Roman notation without zero or position value.

The general adoption of the Hindu system was greatly facilitated by the facts that it was explained in most of the calendars for more than a century beginning with 1300, and that the medieval universities frequently offered courses devoted to the use of this notation. With the opening of the medieval universities we approach some of the fundamental discoveries in more modern mathematics. As we considered these on a similar occasion,* we shall merely add a few thoughts on the concept of dimensions which are due to Plücker.

The idea of more than three dimensions can be partially explained in a very simple manner. If the total number of points on a straight line is denoted by ∞ (the symbol for infinity), it is clear that there are ∞^2 points in a plane, since through each point of the given line we may draw a line at right angles to this line. Each of these ∞^2 points of the plane may be taken as the center of an infinite number of circles, and all the circles which have one point as center are distinct from those which have any other point as center. Hence there are ∞^3 circles in a plane, while there are only ∞^2 points in it.

* SCIENCE, Vol. XL. (1900), p. 528.

We arrive at the same result by observing that an infinite number of lines may be drawn through each point of a plane and that each of these lines is tangent to an infinite number of circles going through this point. Hence ∞^2 circles pass through each point of a plane and lie entirely in the plane. As the number of points on a circle is infinite, the number of circles is obtained by multiplying the number of points by ∞. Hence we say that the plane is two-dimensional when the point is considered as the element, but it is three-dimensional if the circle is considered as element. If the ellipse were taken as element it could be readily shown that the plane would be five-dimensional.

Similarly space is three-dimensional if the point is taken as element but it is four-dimensional if the sphere is taken as element. Since there are ∞^6 pairs of points in space and ∞^2 pairs of points on a line there are ∞^4 lines in space, that is there is a 1, 1 correspondence between the lines and spheres of space. This is frequently expressed by saying there are just as many spheres in our space as there are lines, while the number of each of these is infinitely larger than the number of points. From this standpoint there is no limit to the number of dimensions of ordinary space.

G. A. MILLER.

SCIENTIFIC BOOKS.

The Yucceæ. By WILLIAM TRELEASE. From the Thirteenth Annual Report of the Missouri Botanical Garden. Issued July 30, 1902. St. Louis, Mo. Published by the Board of Trustees. 1902. 8vo. Pp. 107.

The Spanish bayonets are shrubby or tree-like plants, principally of the genus *Yucca*, and represented in gardens by short-stemmed

species bearing evergreen, erect, sharp-pointed leaves. On the Great Plains a common species is known as the 'Dagger-weed.' In the southwest some of the species attain to the dimensions of trees, as *Yucca australis* and *Y. valida,* and are known as 'bear-grass,' 'palma loca,' 'izote,' etc. Botanically they are closely related to the lilies, and in fact are classed as members of the Lily family, of the tribe *Dracænoideæ,* and subtribe *Yucceæ.* All are natives of North America (including Mexico) and Central America.

In this paper the author describes thirty-four species and forty-five varieties and 'forms.' These are distributed quite unequally among five genera, as follows: *Hesperaloe,* two species, and one variety; *Hesperoyucca,* one species; *Clistoyucca,* one species; *Yucca,* twenty-eight species, and forty-five varieties and 'forms'; *Samuela,* two species. The species of *Hesperaloe* occur in Texas and Mexico, and have narrowed flowers, in contrast with the remaining genera, in which the flowers are broad. The single species of *Hesperoyucca* occurs in California, and may be recognized by its filiform style. In *Clistoyucca,* in which the style is wanting, we find a single branching arborescent species, which attains a height of twenty to twenty-five feet or more, and a stem diameter of nearly two feet. It occurs in the Mohave Desert of California, northwestern Arizona and southwestern Utah, where it is known as the 'Joshua tree.' The numerous species, varieties and 'forms' of *Yucca* are widely distributed, extending from South Dakota southward to central Mexico, and from the Atlantic Ocean to the Pacific. Species occur also in Central America, the Bermuda Islands and the eastern Antilles. The genus is distinguished by the polyphyllous flowers and short style. The plants range from acaulescent, as in *Yucca filamentosa* and *Y. flaccida,* to arborescent, as in *Y. australis* and *Y. valida,* which may attain a height of twenty-five to thirty feet. *Samuela* is a new genus erected by the author to include the species with tubular, gamophyllous flowers. Its two arborescent species are natives of Texas and northern Mexico.

One outcome of the studies on which this monograph is based is the conclusion that most of the Spanish bayonets grown in gardens under the old name of *Yucca filamentosa* are not of that species, but are varieties of the allied species, *Yucca flaccida.* The two species may be distinguished by the more rigid leaves, which bear coarse, curly threads in *Y. filamentosa,* and the more flexible leaves, bearing finer, straighter threads, in *Y. flaccida.*

The yuccas are of some value economically. All possess very fibrous leaves, and it is said that 'local use is made of the fiber almost everywhere that the plants grow.' The trunks of the larger species are locally used in the building of houses, palisades, etc., and the leaves are used for thatching. On account of their saponifying properties the stems and rootstocks of some species are used as a substitute for soap, and the species so used bear the local names 'amole,' 'soapweed,' 'soap plant,' etc. Apparently some use is made of this saponifying constituent in the manufacture of certain proprietary soaps and detergent compounds. The flowers and young leaves of many species are greedily eaten by cattle. In the Nebraska sandhills the present writer has seen many examples of plants which had been broken down and their young leaves eaten by the hungry cattle, and in these regions it is very difficult to find complete flower panicles, on account of the greediness of the cattle in eating the succulent flowers. In Mexico the flower clusters of *Samuela carnerosana* are gathered for feeding to sheep and other domestic animals, and it is the practice of the inhabitants to split open the thick trunks of this species in order that the succulent interior portions may be eaten by stock. The fruits of the baccate species are eaten by the natives, as are the young flower buds of some species when roasted or boiled. The seeds are ground and used as meal or boiled into a mush for human food, in some localities. Lastly, attention may be called to the ornamental value of many species, and for this purpose they are largely employed, especially in gardens and parks of considerable extent. They are not adapted to small

grounds, where their sharp-pointed leaves are quite annoying.

It is not necessary to refer at length to the well-known dependence of the yuccas upon certain insects for the deposition of the pollen on the stigmas of the flowers, since that has been so frequently described by many observers. Such dependence seems to be general throughout the group. Even in *Samuela*, with its oddly narrowed, tubular perianth, the common yucca-moth (*Pronuba yuccasella*) is shown to be the agent in pollination.

The monograph is richly illustrated by eighty-eight plates of plants and their fruits and seeds, besides twenty-four maps showing the distribution of the species. American botany is to be congratulated on the publication of this admirable monograph.

CHARLES E. BESSEY.

UNIVERSITY OF NEBRASKA.

A List of North American Lepidoptera, and Key to the Literature of this Order of Insects. By HARRISON G. DYAR. Bulletin 52, U. S. National Museum. 1902 [February, 1903]. Pp. 723.

For many years the guide and companion of the European lepidopterist has been Staudinger's 'Catalogue of the Lepidoptera of the Palæarctic Faunal-region.' The veteran author of that work has now died, leaving us a new edition, prepared in conjunction with Dr. H. Rebel. In America we have had nothing equivalent to Staudinger's catalogue, although Dr. J. B. Smith's useful check-list of 1891 served to indicate the names and classification of the species. At last, however, Dr. Dyar has given us a detailed catalogue, including full references to literature and brief indications of localities. In preparing this work, Dr. Dyar has been assisted by Dr. C. H. Fernald, Rev. Geo. D. Hulst and Mr. August Busck, as is carefully acknowledged on the title-page; he has also utilized previous lists, so far as they proved serviceable. The literature of the subject has been searched with extraordinary care, and full advantage has been taken of the most recent advances in our knowledge of the classification of the Lepidoptera, many of them due to Dr. Dyar himself. While there are of course a few errors in copying or printing, these are extremely few, and the work as a whole is exceedingly well done. If any of us are inclined to regret that a man like Dr. Dyar, one of the most original and gifted investigators in America, should spend his time in preparing a catalogue, we may console ourselves by recollecting the character of some other catalogues, prepared by men of less ability. In truth, the thing was well worth while, and its value to students of American lepidoptera can hardly be overestimated.

The Staudinger and Rebel catalogue for the Palæarctic Region, published in 1901, includes the names of nearly 4,800 species. Dyar's list (including 44 interpolated since it was made up) includes 6,666 species, occurring in America north of the Mexican boundary and the West Indies. This is not precisely equivalent to the Nearctic region, as it excludes the tableland of Mexico, and includes certain Neotropical elements represented in southern Florida. In all probability, our region is much richer in species than the Palæarctic, as it is quite certain that our lists are very incomplete in respect to the smaller moths. In parts of the southwest, indeed, it appears that new species of microlepidoptera are so abundant that the most superficial collector can not fail to find some, while the harvest to be reaped by systematic collecting and breeding is almost unlimited.

It is difficult to determine exactly the degree of resemblance between the lepidopterous faunæ of the Palæarctic and Nearctic regions, but while the two have even a number of species in common, they are in most respects very different. Taking the index of the Palæarctic (Staudinger and Rebel) catalogue, I find 326 valid genera enumerated under the first three letters of the alphabet. Of these, only 97, or less than 30 per cent., are found in Nearctic region. The difference would seem even greater if one took the names just as they stand in the two catalogues, because different views about nomenclature have given us in many cases different names for the same genus. It is very likely that a more exact comparison between the Palæarctic and Ne-

arctic genera will lead us to unite many supposed to be distinct, but the fact will remain that the two faunæ are very dissimilar. Every lepidopterist who has collected on both sides of the Atlantic can remember conspicuous European genera wanting in America, and *vice versa*. In a work of such magnitude as the one under review there are of course some things that may be criticised adversely. A few of these may be regarded as simple errors, but most are objectionable to the reviewer only because his opinions differ from those of the author. The greatest fault, as it seems to me, is the illogical treatment of varietal names, but it must be confessed that their proper treatment is a matter of great difficulty. If it were proposed to discard all names applied to mutations or seasonal forms, and let the trinomial always stand for a geographical race or subspecies, this would at least be logical. In the list, however, we find pure synonyms, names of aberrations and some names of geographical races, lumped together as synonyms of the species, so that it looks to the uninitiated as if modern writers had proposed new specific names for the commonest and best-known butterflies! On the other hand, as valid varieties appear subspecies, seasonal forms and in some cases mere individual variations. Under *Eurymus*, the albinic females of two species appear as valid varieties, while precisely similar forms of others are placed in the synonymy or wholly ignored. The fact is, our American lepidopterists have been so busy describing the new species continually coming to hand, that they have not had time to consider a philosophical plan for recording the different kinds of variation. This work, hitherto somewhat despised, is for the future, and when it is properly done we shall see its great value from the standpoint of evolution.

The treatment of localities in the list is unsatisfactory, being in many instances incomplete, some few species being only recorded as coming from a foreign country, though we presume from their presence in the catalogue that they have been taken in the United States. A really adequate account of the distribution of the American lepidoptera could not be prepared at the present time, as its necessary basis, a good series of local lists, does not exist.

Several species are very briefly described as new in the list. The descriptions are hardly adequate, and no precise localities are given, but I understand from Dr. Dyar that a future paper will remedy these deficiencies. Several generic names are changed because of homonymy; some of the changes have been made because of prior similar but not identical names, such changes being, in my opinion, unnecessary and undesirable. It has been overlooked that *Trama* is the name of a genus of Aphididæ. The later lepidopterous *Trama* (Harvey), *Bull. Buff. Soc.*, 1875, may be called *Lepidotrama*, a name I had given it in MS. some years ago. The species are *Lepidotrama detrahens* (Walker), *L. hinna* (Geyer) and *L. griseipennis* (Grote). The butterfly genus *Tachyris*, described by Wallace, is curiously credited to Wallengren. The generic nomenclature of the butterflies follows in the main the conclusions reached by Scudder many years ago, and is consequently materially different from that in current use. The actual omissions are very few; one notices at the very beginning the absence of *Parnassius nomion minor* Elwes, and *Iphidicles ajax floridensis* (Holland). For no. 475, I would write *Copæodes waco* (Edw.), and *C. waco procris* (Edw.), the name *waco* being the older. The printing of the work is admirable, but the binding is very poor.

T. D. A. Cockerell.

East Las Vegas, New Mexico,
February 28, 1903.

Disinfection and Disinfectants. By Dr. M. J. Rosenau.

This book containing 350 pages is divided into three sections. The first part deals with the best of the disinfectants and insecticides in common use. The second deals with the places and objects to be disinfected. In the third part the important communicable diseases are considered separately, and the characteristics of the bacteria peculiar to them and the special means required to destroy them described. Malaria and yellow fever are given special mention.

The book is a safe and valuable guide and should prove very useful to health officers, physicians and all intelligent persons who desire to understand the principles of disinfection. There is only one important statement that I take exception to, and here the error is on the side of safety. It is stated that disinfection with the fumes of burning sulphur requires eighteen to twenty-four hours, and that the injurious effect on fabrics of this disinfectant contracts its use to narrow limits.

In places where each family occupies an entire house it may be possible to require people to vacate rooms for eighteen hours, but in tenements such as occur in cities this is impossible. We have found, however, that when a room is tightly sealed and four pounds of sulphur are burned to each 1,000 cubic feet, disinfection is practically complete in eight hours, when penetration is not required and the microorganisms to be killed are not more resistant than those met with in diphtheria and small-pox. Its cheapness, ease of use and its value as an insecticide cause us to use sulphur rather than formaldehyde in the rooms requiring disinfection in the tenements of New York city.

Wm. H. Park.

Mineralogy. By H. A. Miers. The Macmillan Co., 8vo. Pp. 584.

Mr. Miers, for a long time connected with the mineralogical department of the British Museum and now professor of mineralogy in the University of Oxford, has had unusual facilities for the study of mineral specimens, and his book is the result of many years of labor. As stated by the author in his preface, the volume is not an exhaustive system of mineralogy, but is intended rather as a treatise in which students will find all that is required for an elementary acquaintance with the subject. The difficult subjects of mathematical crystallography and the physical properties of crystals are treated carefully and with much detail, and the chapter on the optical properties of crystals is especially helpful and suggestive. In the part treating of descriptive mineralogy, comprising about one half of the volume, essentially the same classification as adopted by Dana is followed. In the description of species the crystallographic characteristics are given with much detail, and the text is illustrated not only by the usual outline figures of crystals, but also by numerous carefully executed and effective shaded drawings, many of them of characteristic specimens in the British Museum. At the close of the volume there are given tables of minerals arranged according to the chemical classification, optical properties and specific gravity.

The book is one which advanced students will find useful in the study and comparison of specimens, but it is scarcely elementary enough to serve as a text-book for beginners. The volume is handsomely gotten up, and in this respect may serve as a model for books of its kind.

S. L. Penfield.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for February opens with an important paper on 'The Structure and Relationships of the American Pelycosauria,' by E. C. Case. The author concludes that all known reptiles from the American Permian possessed two temporal arches and that the Pelycosauria followed a line of development here that led to extinction, the persistent line of development being followed elsewhere. These points are dwelt on in a description of the cranial features of various species. V. Sterki presents some 'Notes on the Unionidæ and their Classification,' and gives a scheme of classification, differing somewhat from that of Simpson, based largely on the structure of the hinge, shape of the embryonic and adult shells, and condition of the marsupia. E. L. Mark describes 'A Paraffine Bath Heated by Electricity,' intended to do away with the danger of explosion that attends the use of gas. The number contains the Quarterly Record of Gifts, Appointments, Retirements and Deaths.

The February number of the *Botanical Gazette* contains the first half of a paper by Dr. E. B. Copeland on 'Chemical Stimula-

tion and the Evolution of Carbon Dioxid.' In this part he summarizes previous contributions to the subject and describes improved apparatus for respiration experiments, and an accurate method of titration, on which the somewhat surprising results to be set forth in the second instalment are based.—Professor Charles S. Sargent enumerates the species of 'The Genus *Cratægus* in Newcastle County, Delaware,' including notes on the old species, and the description of eight new species and two new varieties.—Mr. William H. Long, Jr., monographs 'The Ravenelias of the United States and Mexico.' From the genus *Ravenelia,* the species *R. Holwayi,* having æcidia without pseudoperidium, is separated to constitute the genus *Neoravenelia,* and the six species having the inner teleutospores two-celled are segregated as a new genus, *Pleoravenelia.* Three new species of *Ravenelia* and two of *Pleoravenelia* are described. Diagnostic structures of the various species are shown on the two double plates.—Frederick H. Billings has found chalazogamy in the pecan, whose close alliance with the walnut, in which this mode of tube entry was first described, makes the discovery seem quite natural. Mr. W. C. Coker contributes various brief notes; one on leaf variation in *Liriodendron;* another on the occurrence of two egg cells in the archegonium of *Mnium,* from each of which a ventral canal cell is cut off; another on the nucleus of the spore cavity in prothallia of *Marsilia.* This nucleus enlarges greatly as development of the prothallium proceeds, protrudes two or more arms and filaments toward the prothallium, and later fragments amitotically.—Mr. Westgate reviews Gerhart's book on dune work in Germany, and Mr. Howe the volume of Boppe and Joylet on the forests of France.—There are nine pages of notes on current literature and three pages of news items.

The Popular Science Monthly for March contains some 'Hitherto Unpublished Letters of Charles Darwin,' an account of 'The Vienna Academy of Science,' by Edward F. Williams, and the eighth paper by Frederick A. Woods on 'Mental and Moral Heredity in Royalty,' which considers the evidence from Lehr's Genealogy. Edwin G. Dexter considers 'High-Grade Men: In College and Out,' presenting some evidence to show that men who stand high in college retain their position in after life. Raphael G. Zon discusses 'The Source of Nitrogen in Forest Soil' and R. H. Thurston 'Education for Professions,' summing up that prerequisites for success are perfect training of body, brain and soul. John Quincy Adams considers 'Science *versus* Art-Appreciation,' but we believe he errs in stating that science has not only driven art into the background, but has misrepresented its character. The concluding article is by S. W. Williston, on 'The Fossil Man of Lansing, Kansas,' giving a good description of the conditions under which the remains were found and a careful consideration of the possible age of the specimen. 'The Progress of Science' contains critical articles on the Smithsonian Institution and Carnegie Institution.

The Plant World for February contains the third instalment of 'Extracts from the Note-Book of a Naturalist on the Island of Guam,' by W. E. Safford, 'Notes on the Flora of Central Chile,' by George T. Hastings, 'Conditions of Plant Growth on the Isle of Pines,' by W. W. Rowlee and other shorter articles.

The Museums Journal of Great Britain for February has 'A Design for the Tops of Table Cases,' by A. Jukes-Brown, and a consideration of 'The Use of Museums in Teaching,' by W. E. Hoyle, with special reference to the Manchester Museum. Among the notes is one entitled 'A Statesman's View of Museums,' showing the high value set on them by Mr. James Bryce, and the announcement of the completion of a large additional building for the Kew Herbarium.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES. SECTION OF GEOLOGY.

A regular meeting of the Section of Geology and Mineralogy was held on the evening of February 16, at the American Museum of Natural History, with Professor J. F. Kemp in the chair.

Professor William Hallock read the first

paper, on 'An Ascent of Mt. Whitney, California, with Notes on the Geology.' Mt. Whitney, with an altitude of 14,625 feet, claims the distinction of being the highest peak in the United States. It is a mountain of high relief in a rugged country. The easiest way to the summit is by a five-day journey skirting the canyons from the southwest. Sedimentary rocks are not met with in this part of the Sierras, near Mt. Whitney. The country rock is a deeply weathered granite, split up by countless joint planes. Mt. Whitney exhibits the effects of glacial sculpturing, and holds many small lakes in the cirques, adjacent to its top, which have resulted from ice undercutting. Professor Hallock also described a lava flow with cinder cones on Volcano Creek, Cal. Lantern slides were used to bring out these features, and to illustrate the topography.

Professor Kemp read the second paper, on 'The Leucite Hills of Wyoming.' Before giving an account of his work in this region with Professor Wright, of Wyoming University, he described the mineralogical and petrographical features of the leucite rocks as they occur in America, and referred to their discovery in Wyoming by the members of the 40th Parallel Survey. These rocks were originally described by Dr. Zirkel. The speaker then called attention to Dr. Cross's more extended work in the district. His own contribution had to do with the general geology of the Leucite Hills. As many as seventeen separate mesas and buttes isolated by erosion have been mapped, representing in most cases single extrusive and intrusive flows of these rare rocks. They are found in sandstones near the top of the Cretaceous, and their distribution and field relations tend to confirm the view that they are volcanic outpourings at different times from a laccolithic reservoir of great extent, which is nowhere exposed at the surface. Lantern slides were used in illustrating the geology, and specimens of the rocks in question were exhibited.

GEORGE I. FINLAY,
Secretary pro tem.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

February 13.—The concluding discussion of the new classification of the igneous rocks was opened by Professor Kemp. It was actively participated in by members of the club. The educational aspect of the subject was particularly considered.

Dr. Julien reviewed two short papers from a late number of the *Bulletin de la Société Geologique de France.*

February 20.—Mr. D. W. Johnson reviewed a paper by W. M. Davis on the 'Fresh-water Tertiary Formations of the Rocky Mountain Region,' and then gave a paper on the 'Fluviatile Origin of the Santa Fe Marls in New Mexico.' This paper aroused much discussion. Dr. A. F. Rogers exhibited some specimens of galena showing multiple twinning.

February 27.—Dr. Julien reviewed several papers in a late number of the *Bulletin de la Société Geologique de France,* especially an essay by H. Douvillé on the 'Revision and Distribution of Orbitolites and Orbitoides from the Chalk.' Professor Grabau reviewed a late paper by Mr. Schuchert on the 'Lower Devonic and Ontaric Formations of Maryland.'

H. W. SHIMER.

THE CONNECTICUT BOTANICAL SOCIETY.

THE society was organized in New Haven, January 24, 1903, and the following officers elected:

President—Professor Alexander W. Evans.
Vice-President—Dr. C. B. Graves.
Recording Secretary and Treasurer—Dr. E. H. Eames.
Corresponding Secretary—Mr. E. B. Harger, Oxford, Conn.

For the compilation of accurate information towards a catalogue of the flora of the state, a committee on the higher plants was appointed, while another on the lower cryptogams remains to be selected.

The former committee consists of Dr. C. B. Graves, New London; Dr. E. H. Eames, Bridgeport; Mr. C. H. Bissell, Southington; Mr. L. Andrews, Southington; Mr. E. B.

Harger, Oxford, and Mr. J. N. Bishop, Plainville.

Several papers were heard with great interest, followed by much discussion on these and botanical matters in general. It was also decided to hold field meetings at intervals through each season, more thoroughly to study the flora of the state, and give additional stimulus to the prosecution of careful work in this direction.

Withal, the meeting was very enjoyable, and indicated a permanently active organization.

Thirty-one members were accepted as organizers of the society and the probability of greatly increased membership is already apparent.

E. H. Eames,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 368th meeting was held Saturday, March 7.

F. A. Lucas exhibited some lantern slides made from photographs taken by R. H. Beck, showing groups of several hundred specimens of *Conolophus cristatus,* one of the two large lizards found on the Galapagos Islands. Mr. Lucas stated that Mr. Beck had taken a large number of photographs showing the more striking features of the fauna and flora of those islands.

Frederick W. True spoke on the 'Attitudes and Movements of Living Whales,' illustrating his remarks by lantern slides showing whales as depicted in books and as they actually appear in life. The species discussed were the large whales pursued for commercial purposes, and the speaker showed that there was considerable discrepancy in the accounts of observers as to their behavior. Under this was included the form and height of the spout, the movements of tail and flippers, duration of stay beneath the surface and method of descending, or 'sounding.' Various observations were plotted on a large diagram, and attention was called to the fact that the closest agreement as to facts was found in observations made on the bowhead and sperm whales, the two species that had been longest hunted and were best known. It was suggested that with better knowledge of other species there would be better correspondence of the observations concerning them.

O. F. Cook presented 'Some Biological Aspects of Liberia,' exhibiting a number of views of the more characteristic features of the flora and describing in detail some of the more interesting trees and plants. It was stated that the oil palm was the only African palm not represented by some species in South America, and attention was called to the fact that this palm was not found in a wild state. Where it seemed to occur wild, observation showed that the spot had formerly been inhabited and the species was preserved and disseminated by the agency of man.

F. A. Lucas.

DISCUSSION AND CORRESPONDENCE.

THE PUBLICATION OF REJECTED NAMES.

In the issue of Science for January 30, 1903, p. 189, Professor T. D. A. Cockerell, under the above caption, calls attention to what he regards as adequate publication of rejected manuscript names by Mr. Banks and myself. As Professor Cockerell very well says, there is evidently a misconception or divergence of opinion among naturalists on this point that it is well worth while to discuss. I have taken the trouble to submit my particular case to some forty workers in systematic biology, and the 'various and sundry' ways that have been suggested for handling the question are certainly surprising, showing that the practice in such cases is by no means uniform. A large number, mainly zoologists, hold that my printing of Lesquereux's manuscript name *Carya globulosa* before the one I intended to give the organism was merely of the nature of narrative or explanation, and did not have the effect of validating the manuscript name. The intent of the author, it is said, is to be respected, and as it is perfectly clear that I intended to name it *Cucumites Lesquereuxii* and not *globulosa,* they hold that *Cucumites Lesquereuxii* stands. Others take an exactly opposite view, namely, that because I printed the manuscript name first and followed it by a description of the

fossil before printing the name I proposed to give it, I thereby validated the manuscript name, and no matter how plain the author's intent may have been, the specific name *globulosa* must prevail. They would, therefore, write the binomial as *Cucumites globulosus*. Accepting this latter view, an immediate and pronounced divergence of opinions arose as to the authority for the specific name and its combination. Some aver that, although I did mention Lesquereux's manuscript name, I was the first to rescue it from the limbo of *nomina nuda* and habilitate it by means of a description and illustration, hence it became my name. Those who hold this view would write it *Cucumites globulosus* (Knowlton), or if using the double citation, as *C. globulosus* (Knowlton) Cockerell, on the ground that Cockerell first actually made the combination in his note in SCIENCE. Others, all of them botanists, claim that *globulosa(us)* was Lesquereux's specific name which I had obligingly published for him, and that the authority should read: *Cucumites globulosus* (Lesquereux) Cockerell. Still others argue that although I did not actually refer *globulosa* to the genus *Cucumites* I virtually did so, and they would write it *C. globulosus* (Lesquereux) Knowlton. This last contingent, while denying the right to interpret my obvious intention to give the plant a new name, insist on supplying me with an intention to do that which I did *not* intend!

Tabulated we have the following results:

Cucumites Lesquereuxii Knowlton. Advocated by twenty-one systematists, mainly zoologists.

Cucumites globulosus (Knowlton). Advocated by two zoologists.

Cucumites globulosus (Knowlton) Cockerell. Advocated by six zoologists.

Cucumites globulosus (Lesquereux) Cockerell. Advocated by eleven botanists.

Cucumites globulosus (Lesquereux) Knowlton. Advocated by two botanists.

It may be worth while to attempt an analysis of the above diverse results to see if it is possible to ascertain the underlying principles which governed the several decisions. Those who advocate the first combination in the above list would seem to be going on the common-sense principle, namely, that the obvious intention of the author should be respected. This, as I understand it, the so-called Kew Rule permits. But it is very much with this as it is when a game is played with cards. It might be most logical for each card to have a fixed value, but when different games are played they are played according to the rules of the particular game, and the cards have the value fixed by the rules of that game. The ornithologists are supposed to be playing, to continue the simile, according to the rules of the American Ornithologists' Union, which, on the point at issue, is as follows:

"§ 5. Of names published simultaneously. Canon XVII., 3. Of names of undoubtedly equal pertinency, * * * that is to be preferred which stands first in the book."

As it is beyond question that the name *Carya globulosa* appears first in my paper, and is followed by a full description of the organism, the above rule would seem to fix *globulosa* as the proper specific name. In the matter of deciding the authority, Canon XXXII. of the A. O. U. code is very plain. This reads: 'A *nomen nudum*, generic or specific, may be adopted by a subsequent author, but the name takes both its date and authority from the time when, and from the author by whom, the name becomes clothed with significance by being properly defined and published.' In conjunction these rules fix the name as *Cucumites globulosus* (Knowlton).

The botanists are supposed to be working under the so-called Rochester rules, and this point is covered in part by Article VI., Publication of Species. 'Publication of a species consists only (1) in the distribution of a printed description of the species named.' As these conditions are fulfilled in my paper, this rule also fixes the specific name as *globulosa*. There appears to be no provision in the Rochester rules for fixing the authority in cases like this one under discussion.

In conclusion I may say that I am forced to agree with Professor Cockerell that *under the rules* the name of the Vermont fossil must

be *Cucumites globulosus,* although I am free to confess that is not the name I had intended it to bear! I would write the name and its authority as *C. globulosus* (Knowlton) Cockerell, and I may add, that, in my judgment, Professor Cockerell has himself further complicated the issue by intentionally publishing a combination in a field in which he has at most only a passing interest.

F. H. Knowlton.

Washington, D. C.

THOSE MANUSCRIPT NAMES.

To the Editor of Science: I am much averse to using the pages of scientific papers for nomenclatorial discussion, but since Professor Cockerell's and Dr. Bather's articles indicate that I introduced MS. names merely to upset them, a few words may not be amiss. Dr. Bather says 'It (*Filistata oceanea*) appears first on page 50 of Mr. Banks's paper.' Such is not the case, and in this very paper (p. 60, bottom) I refer to an unpublished name of Marx but am careful not to introduce it. Dr. Marx (as I state) published a list of spiders from the Galapagos Islands in 1889 which includes six MS. names. In order to make my paper on the spiders of these islands complete it was necessary to note previous publications. In order to show how many spiders were known from these islands I collated the previous lists (Butler's and Marx's) with my material, in so showing that three of Marx's published names were synonyms of previously described species, and two others were the same as those I would describe below. In sinking five of the six previously published names (every one of which is still a *nomen nudum*) under described species I believe I was doing a service. My case is not unique; I can mention dozens; commonly, however, the MS. name is referred to after the description. And the paper and ink wasted in so doing are as nothing to the time and type wasted in the two articles which are the mismated parents of this one.

Nathan Banks.

EXPLORATION OF OKEFINOKEE SWAMP.

To the Editor of Science: Some of your readers may be interested to know that the vast wilderness, several hundred square miles in extent, known as Okefinokee Swamp, in southeastern Georgia, so long avoided by botanists and other scientists—though mentioned as long ago as 1791 in the writings of William Bartram—has at last been penetrated. In company with Mr. P. L. Ricker, of the U. S. Dept. of Agriculture, and a guide, I entered the swamp near the center of its eastern margin on August 6, and came out at the same place on the 8th, having in the meanwhile been about a dozen miles into the interior and secured a considerable number of interesting plants and photographs.

One of the first features of the swamp to attract my attention was the fact that all the thousands of cypress trees seen were undoubtedly *Taxodium imbricarium,* a species whose distinctness from the old *T. distichum* I have recently attempted to show (*Bull. Torr. Bot. Club,* 29: 383–399, June 20, 1902). According to the theory there proposed (see pp. 389, 395) this would seem to indicate that the Lafayette formation underlies the swamp, or at least that part of it visited by us; but direct evidence on this point is still wanting. This formation was actually observed however a few miles east of the swamp, and it is reasonable to suppose that it underlies the whole area.

Lumbering operations in the swamp seem to have been suspended for the last few years (owing mostly, it is said, to the death of the principal promoters of the scheme for deforesting and draining it), and fortunately the natural conditions have been very little altered thereby. The fauna seems to have suffered considerably from the ravages of sportsmen, but the flora is practically intact, and the swamp offers a number of most interesting problems in many branches of natural science.

Roland M. Harper.

Folkston, Charlton County, Georgia,
August 11, 1902.

SOUTHERLY DEVIATION OF FALLING BODIES.

Readers desiring a somewhat fuller historical account of experiments and theories relating to the southerly deviation of falling

bodies than that given by Professor A. Hall in this journal, p. 349, are referred to my article in Science, N. S., Vol. XIV., pp. 853–855. The experiments by Professor E. H. Hall, recently outlined in this journal, p. 181, are extremely interesting. They seem to indicate a minute southerly deviation. Thus nearly all experimentalists on this subject, from the time of Robert Hooke to the present, have found a small southerly deviation. I believe the only exception is Benzenberg, who in 1804 had, for theoretical reasons, come to disbelieve in the actual existence of this deviation, and who, accordingly, found it absent in his experiments of that year after selecting from the total number of trials those only which, in his judgment, were made under the most favorable conditions. I read Benzenberg's and other papers in *Gilbert's Annalen* two years ago and I can not recall that Benzenberg, or any one else, ever announced a *northerly* deviation. In 1802 Benzenberg reported, as a final result of his experiments in Hamburg, a marked southerly deviation. In the following summary, H = height in m., $S.D.$ = southerly deviation in mm., A = average southerly deviation in mm., per meter of fall.

	H.	S. D.	A.
Hooke, 1680,	8.3	+	
Guglielmini, 1791,	78.3	11.89	.15
Benzenberg, 1802,	76.3	3.4	.044
Benzenberg, 1804,	84.4	0.00	.00
Reich, 1831,	158.5	4.374	.028
Rundell, 1848,	400.	250 to 510	.95
E. H. Hall, 1902,	23.	.05	.002

Florian Cajori.

Colorado College,
March 3, 1903.

SHORTER ARTICLES.

PYCRAFT'S CLASSIFICATION OF THE FALCONIFORMES.*

Probably no recent paper on the classification of any group of birds is equal in interest or importance to that by Mr. W. P. Pycraft on the osteology and classification of the Falconiformes, a group in which the crudities of earlier systems have been held on to with a persistence most remarkable in these days of advanced knowledge of avian anatomy. Until the appearance of Huxley's celebrated paper, in 1867* all naked-headed carrion-feeding birds of prey were 'Vulturidæ' (vultures), the superficial resemblance between those of the Old World and those of the New being, in those days of anatomical ignorance, far more obvious than the external differences, marked though they be. Although in separating the American vultures as a distinct family, Cathartidæ, Huxley drove the first nail in the burial case of the old systems, he unfortunately went no farther concerning the typical Falconiformes,† and, therefore, ornithologists have continued to recognize the purely artificial and unnatural minor groups of the older authors. All those of largest size, except vultures, are still 'Aquilinæ' (eagles), in the latest arrangements; all those with exceptionally long wings and more or less forked tails‡ are 'Milvinæ' (kites); all short-winged, long-legged and long-tailed forms 'Accipitrinæ' (hawks); those of heavy build, moderate size and alleged 'sluggish' habits 'Buteoninæ' (buzzards); while those with notched bills are 'Falconinæ' (falcons).

Although, as before remarked, Huxley's paper went scarcely beyond the definition of the three primary divisions of the order, he fortunately gave a valuable clue to further

* Pycraft, W. P., F.Z.S., A.L.S., 'Contributions to the Osteology of Birds,' Part V., *Falconiformes. Proc. Zool. Soc. Lond.*, 1902, Vol. I., Part ii., August 1, 1902, pp. 277–320, pls. xxxiii.–xxxvii.

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* 'On the Classification of Birds; and on the Taxonomic Value of the Modification of certain of the Cranial Bones observable in that Class,' by Thomas H. Huxley, F.R.S., V.P.Z.S. *Proc. Zool. Soc. Lond.*, 1867, pp. 415–472. (The Ætomorphæ, = Falconiformes + Striges, treated on pp. 462–465.)

† He divided the so-called diurnal raptores into three groups, Cathartidæ, Gypaëtidæ, and Gypogeranidæ, each equivalent to the suborders Cathartæ, Accipitres, and Serpentarii of Pycraft.

‡ All these artificial groups, however, contain forms which do not conform to the diagnoses of said groups, some so-called 'kites,' for example, having a truncated or even rounded tail, and some 'eagles' being no larger than the average hawk.

investigation within the group which he called Gypaëtidæ (*i. e.*, the Accipitres) in certain variations of the coracoid and scapula. Taking up this clue, the present writer published, in 1873–1876, a series of papers on the classification of the Accipitres, and in the first of these* indicated a new grouping of the genera, but without definition of their characters, the salient feature of the new arrangement being the separation of the true falcons (Falcones), laughing falcons (Herpetothereæ), wood falcons (Micrastureæ) and caracaras (Polybori) as a subfamily (Falconinæ), the remaining members of the order being segregated into minor groups under the subfamily heading Buteoninæ. This arrangement was further elaborated, with slight modifications as to some of the minor groups, in 1875 † and again in 1876.‡

This 'new arrangement,' so radically different from any other, found little favor among ornithologists, and had apparently become forgotten; therefore, the author hopes that he may be excused the surprise and gratification which he naturally feels to find in Mr. Pycraft's paper, published nearly thirty years later, a classification so closely identical with his own that differences of nomenclature constitute almost the only points of divergence. No mention of the present writer's papers of 1873–76 on the same subject being made by Mr. Pycraft, it is probable they were unknown to him, or at least that he never saw them, a probability the more gratifying since results which have been independently reached by two widely separated investigators must, necessarily, be sound; and now that the 'stamp of authority' has been given to the present writer's long ignored arrangement, it will be safe for the conservative ones to shake off their adherence to antiquated and obviously unsound classifications of the group and adopt the modern one. The latter, it is hardly necessary to remark, is of course susceptible of much improvement, especially as to the number and limits of the minor groups (called subfamilies by Mr. Pycraft), there being still many forms whose osteology has not yet been studied.

In order to show how very closely the present writer's arrangement of 1873–76 coincides with Mr. Pycraft's of 1902, the two are compared in parallel columns, with a few necessary explanatory notes:

Ridgway (1873–76).	Pycraft (1902).
FALCONINÆ (1873).	FALCONIDÆ.
Falcones (1873).	Falconinæ, part.
Polybori (1873).	Polyborinæ.
Micrastureæ* (1873).	Falconinæ, part.
Herpetothereæ† (1873).	Falconinæ, part.
BUTEONINÆ (1873).	BUTEONIDÆ.
Pandiones‡ (1873).	Pandioninæ?
Pernes§ (1873).	Perninæ, part.
Elani‖ (1873).	Elaninæ.
Ictiniæ¶ (1873).	Milvinæ, part?
Elani* (1873).	Circinæ,** part.

* Changed in 1875 to Micrastures.

† Changed 1875 to Herpetotheres.

‡ My Pandiones originally included *Elanoides*, which in 1875 I transferred to Pernes, where it is placed by Mr. Pycraft.

§ My Pernes included the genera *Pernis*, *Baza*, *Avicida* '*Cymindis*' (*Odontriorchis*), and *Regerhinus*. To these Pycraft adds, doubtfully, *Pandion*, not being satisfied as to the propriety of separating it as a subfamily. *Elanoides* was added to the group by me in 1875.

‖ My Elani originally included only *Elanus* and *Gampsonyx*, but *Nauclerus* was added in 1876. Mr. Pycraft does not mention the last, but includes *Machœrhamphus*, a genus which I had not been able to examine.

¶ This group includes *Ictinia* and *Harpagus*, the former being doubtfully referred by Pycraft to the Milvinæ (where most certainly it does not belong), while the latter is not mentioned by him. *Rostrhamus* is also doubtfully referred by Pycraft to the Milvinæ, a group to which it seems to me to be not at all nearly related.

** Pycraft includes, besides *Circus* and '*Strigiceps*,' the genera *Urotriorchis* and *Geranospizias*,

* 'Catalogue of the Ornithological Collection in the Museum of the Boston Society of Natural History,' II., Falconidæ. *Proc. Boston Soc. Nat. Hist.*, XVI., May 21, 1873, pp. 43–106.

† 'Outlines of a Natural Arrangement of the Falconidæ,' *Bull. U. S. Geol. and Geog. Surv. Terr.*, No. 4, second ser., June 10, 1875, pp. 225–231, pls. xi.–xviii.

‡ 'Studies of the American Falconidæ,' *Bull. U. S. Geol. and Geog. Surv. Terr.*, ii., No. 2, April 1, 1876, pp. 91–182.

Geranospizæ (1873).*	Circinæ, part? (or Circætinæ, part?).
Urubitingæ (1873).	Urubitinginæ,† + Buteoninæ, part.
Buteones (1873).	Buteoninæ,‡ part.
Haliaeti§ (1873).	Milvinæ.
Aquilæ‖ (1873).	Aquilinæ.
Circaëti¶ (1873).	Circaëtinæ.
Archibuteones** (1873).	Buteoninæ, part.
Morphni (1876).	Thrasaëtinæ.

The only group of Mr. Pycraft's classification having no equivalent in my arrangement is his subfamily Vulturinæ (comprising the genera *Gypohierax, Neophron, Gyps, Vultur* and *Otogyps*††). This subfamily he locates between the Thrasaëtinæ and Circaëtinæ, a position not far different from that I would have given it had occasion required, as is indicated on page 227 of my 'Outlines.'

That Mr. Pycraft was unable to give the preparation of his paper the amount of time and care which the subject would have justified is obvious from several slips, nomenclatural and otherwise. For example, he places the Polybori (his Polyborinæ) both in the Falconidæ and Buteonidæ (p. 315), and *Geranospizias* in both Circaëtinæ and Circinæ! In different places the terms Accipitridæ and Buteonidæ are used for the same family. There are also some errors in the explanations to the plates, fig. 10, pl. 32, representing *Catharistes*, not *Serpentarius*, Fig. 11 on the same plate being the latter, though not so indicated in the text on p. 320; while Fig. 5, pl. 32, is *Polyborus*, not *Ibycter*, as stated.

On the whole, Mr. Pycraft's paper is an excellent and most important contribution to a very interesting ornithological subject, and it is to be hoped that after extending his investigations to numerous forms not mentioned by him and therefore presumably not examined, he may finally give us the benefit of his studies in a more elaborate treatise.

ROBERT RIDGWAY.

U. S. NATIONAL MUSEUM,
December 11, 1902.

* My Geranospizæ included *Polyboroides*, a genus not mentioned by Pycraft.

† Whether Pycraft would include more than *Urubitinga* is uncertain. My group contained, in addition to that genus, *Buteogallus, Heterospizias*, and *Parabuteo* ('*Antenor*'), the last of which Pycraft places in his Buteoninæ, the other two not being mentioned by him.

‡ Pycraft's Buteoninæ includes *Archibuteo*, which I had placed by itself, *Parabuteo* ('*Antenor*'), which I placed in Urubitingæ, and *Busarellus*, which I put with Haliaeti.

§ My Haliaeti included *Thalassoaëtus, Haliaeëtus, Polioaëtus, Haliastur, Milvus*, and *Busarellus*, to which I would now add *Gypoictinia*. Pycraft's Milvinæ includes *Haliaeëtus, Polioaëtus, Haliastur*, and *Milvus*, to which are *very doubtfully* added *Ictinia* and *Rostrhamus*.

‖ My Aquilæ at first included, besides the genera comprising Pycraft's Aquilinæ, *Harpyhaliaëtus, Morphnus*, and *Thrasaëtus*, but in 1876 the last two were taken out and designated as a separate group, Morphni, exactly equivalent to Pycraft's Thrasaëtinæ. The correct position of *Harpyhaliaëtus* is, with me, a matter of doubt, but I am now inclined to the opinion that it should either go into the Urubitingæ or constitute a monotypic group.

¶ My Circaëti consisted of *Circaëtus, Spilornis*, and *Helotarsus*; Pycraft's of the first and last, the second not being mentioned by him.

** Consisting of *Archbuteo* only.

†† It would be interesting to know where Mr. Pycraft would place *Gypaëtus*.

though the latter he places *also* in Circætinæ! *Urotriorchis* I have not been able to examine, but *Geranospizias* is certainly not closely related to *Circus*, but seems to come very near to *Polyboroides*.

ELEPHAS COLUMBI AND OTHER MAMMALS IN THE SWAMPS OF WHITMAN COUNTY, WASHINGTON.

ON the 27th of November, 1877, on my way down the Columbia River, from the Dalles, Oregon, I met an army surgeon who told me of a deposit of extinct animals, discovered the year before in 'mud-springs,' in the swamps of Pine Creek valley, Whitman County, Washington, about 100 miles north of Walla Walla. Mr. Copeland, in probing one of these springs on his farm with a long pole, thought the end entered the occipital foramen of a large skull. He had a long iron rod with grappling hooks at the end made. With this tool, and with the assistance of his neighbors he was able to dislodge and bring to the surface a very complete skull of the

mammoth. Continued labor recovered from the bed of gravel below a large part of the skeleton, all beautifully preserved. This aroused a great deal of excitement in that region. While the curiosity of the people was at white heat, a showman bought the skeleton for a thousand dollars, and put it under canvas for public exhibition. I afterward met this gentleman, who offered the specimen, securely packed for transportation at San Francisco, for a few hundred dollars. I wrote to Professor E. D. Cope, in whose employ I was, giving him all the particulars, and address of the possessor, whose name I have now forgotten. On the strength of the information given me by the surgeon, I resolved to conduct an expedition to the Pine Creek region. I left Fort Walla Walla sometime in January, 1878. At Moscow, Idaho, I secured the services of Joe Huff, who furnished a team and wagon. We pressed on through Colfax to Pine Creek (it heads in the high hills not far from where we came to it, at a stockade that had been built to protect the settlers from Indians a few years before; we made our permanent camp here), and spent most of our time until April, when we started for the John Day region, in eastern Oregon. The mouth of the spring we explored was only two feet above the creek. To add to our discomfort, it rained nearly every day; but with unfailing enthusiasm we bailed mud and water week after week. The larger we got the excavation, the more water to bail out. In enlarging the pit we found the walls of the spring were composed first of a thick bed of peat, then a stratum of compact yellow clay, then gravel, in which the bones were deposited, about twelve feet below the surface. In spite of our strenuous labors, we were only rewarded with the discovery of a number of fine skulls of the buffalo. In one we found a flint arrow-point and bones of the skeleton. The farmer-fossil-hunters had been more fortunate. The so-called 'mud-springs' in this region often cover acres of swamp land along the upper reaches of Pine Creek. They usually have a circular outline, and are full of thick mud; in wet weather they are in a state resembling ebullition. In very dry weather they are covered with a crust of dried mud that is cracked in all directions. These crusts not being strong enough to support much weight, they become death traps to the animals that attempt to cross them. Many of the farmers' animals were lost in them. On March 1, 1878, I met Mr. Copeland for the first time. He told me he had taken nine specimens of the mammoth from the swamp on his ranch. These, as I remember, he had deposited in a college in Forest Grove, Oregon. He discovered a flint spear-point in the gravel above the mammoth bones, associated with charred and partly petrified wood that bore the marks of tools upon it, also deer, buffalo and bird bones. On March 2 we went with Mr. Copeland to see the springs on the Donahue brothers' ranch up Pine Creek. Here the swamp covered seven or eight acres, and the owners had made large excavations. I was told they had recovered a large number of elephant remains. I found on the dump a few elephant bones, with those of the buffalo, deer, etc. I do not remember what became of the specimens discovered by these gentlemen. Although I did not actually find elephant bones mingled with the buffalo we found so common in our spring, I never doubted, from what I saw and heard at the other excavations in the immediate neighborhood, and where the collectors went through the same kind of peat, clay and gravel as we had gone through, that man, the buffalo, elephant and many existing species once lived together in eastern Washington. It seems to me these swamps should receive careful attention from paleontologists. A systematic series of explorations here may give valuable information of early man and the animals with whom he associated.

The skull of *Elephas Columbi* above referred to is now in the collection of the American Museum of Natural History, with other fossils of the Cope collection.

Charles H. Sternberg.

HERBARIA FORMATIONUM COLORADENSIUM; F. E. ET E. S. CLEMENTS.

One of the phases of botany now in active advance both in this country and abroad is

ecological plant-geography, or phytogeography, the study of the ecology of the vegetation of particular regions. It aims to elucidate the factors determining not only the adaptations of species (*vegetation forms*) to their habitats, but also their association into groups (*formations* [*societies*], *associations*, etc.) constituting the plant-life of any region, a subject of the greatest educational and popular, as well as scientific, interest. Such investigation is still so new as to exhibit many of the crudities of youth, and its methods and terminology are yet undifferentiated; but the field is attractive and promises rich results to a truly scientific attack. In this country there are three active centers of phytogeographical study, the universities of Nebraska, Chicago and Minnesota. Under the auspices of the botanical seminar of the University of Nebraska, Drs. Pound and Clements have published a volume, 'The Phytogeography of Nebraska' (Second ed., 1900) which represents the most extensive and thorough ecological study, from a scientific standpoint, of the vegetation of a particular region which has been attempted in this country. And now one of the authors, Dr. Clements, has taken the lead in a work of another kind which is likely to be much followed in the near future, namely, the preparation of sets of herbarium specimens, supplemented by photographs, to illustrate by these two most accurate of available methods the phytogeography of an important region in the Rocky Mountains, and he has placed a number of these sets at the disposal of other institutions and students.

This collection consists of herbarium specimens of standard size and most excellent preservation illustrating some 533 species of prominent Colorado mountain-plants, supplemented by 101 photographs 6 x 8 inches, the great majority of which leave nothing to be desired in the clearness of illustration of their subject and in artistic photographic excellence. They are selected to show either individual prominent plants (the vegetation forms), or associations of these (facies) or the larger groups occupying characteristic situations (formations), while a few illustrate special features of reforestation, etc. Equally important with specimens and photographs are the labels, of which a specimen taken at random reads thus:

HERBARIA FORMATIONUM COLORADENSIUM

F. E. et E. S. CLEMENTS.

93. *Gentiana affinis* Griseb.

Herba rhizomatica endemica, Minn-NM-Nev-BC., species principalis aspectus autumnalis Pinus ponderosa-flexilis-xero-hylio.
Crystal Park 2600 m. 4 Septembris 1901.

The labels thus give, in addition to the more usual information, a short characterization of the vegetation form and a mention of its place in a particular formation, *e. g., the Pinus ponderosa and flexilis dry forest.* The labels thus embody Dr. Clements's new proposals for phytogeographical nomenclature, an extremely carefully and judiciously elaborated system which the author has since published in Engler's 'Botanische Jahrbücher' (Beiblatt No. 70, 1902). His system consists essentially of the naming of formations by combining the genus (and species) names of the prominent vegetation forms with terms from Latin and Greek roots precisely descriptive of the habitats. It is of course yet too early to permit of any prediction as to how widely the system will be followed, but there can be no doubt that it is much the most serious attack upon this important problem that has yet been made, and not only must future workers take account of it, but it is very likely to form the foundation of the permanent system. In this admirable collection Dr. Clements thus characterizes some sixteen formations, and shows the place in each of the various vegetation forms, while a set of check-labels makes the classification easy and plain. When one examines these specimens in close comparison with the photographs, bringing the two into correlation by use of the labels, he has the means of obtaining the most accurate and vivid impression of the vegetation of this region that can possibly be obtained without an actual visit. For this reason it is altogether likely that the method will be extensively used in the future in the description and illustration of the phytogeography of the different regions of the earth, both as a means

of preserving phytogeographical data for convenient reference, and also for various educational purposes. In this Dr. Clements is the pioneer, and deserves our congratulations upon the success of this first attempt.

It is understood that twenty-four sets (the price of which was very moderate) were prepared, of which all or nearly all have been taken, about a third of them by institutions abroad.

W. F. Ganong.

NOTE ON NEGATIVE DIGITS.

In the common scale of notation 2873 stands for $2000 + 800 + 70 + 3$. The same number might be represented by $3\bar{1}\bar{3}3$ which is intended to mean $3000 - 100 - 30 + 3$. It might also be written $3\bar{1}\bar{2}\bar{7}$ or $29\bar{3}3$, and, indeed, a great variety of ways might easily be found, but the form $3\bar{1}\bar{3}3$ is most advantageous in that the absolute values of the digits are the smallest possible. It is clear that any number may be written so that all its digits shall be less than six in absolute value. In fact, we may replace 9 by $\bar{1}$, 8 by $\bar{2}$, 7 by $\bar{3}$ and 6 by $\bar{4}$, leaving the others unchanged. This amounts to replacing the digit K by $10 - K$, so that we must add one unit to the adjacent digit on the left. We have then the following rules for changing any digit from plus to minus and from minus to plus:

1. *To change a digit from plus to minus, subtract it from* 10 *and add* 1 *to the digit on the left.*

2. *To change a digit from minus to plus, subtract it from* 10 *and subtract* 1 *from the digit on the left.*

In practice one begins on the right and changes successively those digits which are greater than 5. Thus to change 82755637 the 7 on the right goes into $\bar{3}$ and the 3 becomes a 4, the 6 changes to $\bar{4}$ and the 5 adjacent to it becomes 6, which goes into $\bar{4}$ and makes the second 5 a 6. This goes in turn into $\bar{4}$ and changes 7 to 8 or $\bar{2}$ and the 2 becomes 3. The last digit on the left becomes $\bar{2}$, which changes the digit next to it on the left (namely 0) to 1. The whole process then gives

$$1\,\bar{2}\,3\,\bar{2}\,\bar{4}\,\bar{4}\,\bar{4}\,4\,\bar{3}.$$

The reverse process is carried out similarly, and half an hour's practice will enable one to make the change from one notation to the other with little effort of the mind.

The new notation is of little value in addition or subtraction and is entirely useless in division. In multiplication its value, however, can hardly be overestimated. The advantage in using it is twofold. The digits are all less than 6 and there is twice the chance of repeated digits in the multiplier. Thus, in the ordinary method of multiplication, if one has obtained the partial product corresponding to a digit 3 in the multiplier, one obtains the partial product corresponding to a digit $\bar{3}$ by changing the signs of all the digits in the first partial product. In the short method of multiplication given in Science, July 11, 1902, it is difficult to deal with large digits. Thus, to find the product of 987593×86759 by that method would be a difficult and fatiguing task. Changing to negative digits, however, one finds the product can be written out with perfect ease, thus:

$$\begin{array}{ccccccccccc}
1 & 0 & \bar{1} & \bar{2} & \bar{4} & \bar{1} & 3 & & & & \\
 & 1 & \bar{1} & \bar{3} & \bar{2} & \bar{4} & \bar{1} & & & & \\
\hline
\bar{1} & \bar{1} & \bar{4} & \bar{3} & 3 & 2 & 4 & 1 & 1 & 2 & \\
 & & & & 1 & 0 & 1 & 7 & & & \\
 & & & & & & & & \bar{1} & \bar{1} & \bar{3} \\
\hline
 & 8 & 5 & 6 & 8 & 2 & 5 & 8 & 1 & 0 & 8 & 7
\end{array}$$

D. N. Lehmer.

University of California,
October, 1902.

MUSEUM NOTES.

Part X., Volume II., of the *Annals of the South African Museum* is devoted to a continuation of 'The Moths of South Africa,' by G. F. Hampson. The present instalment, comprising nearly two hundred pages, deals entirely with the large family Noctuidæ, and gives keys to the subfamilies, genera and species. The descriptions are very full and include a great number of new species; the greater number of types are in the British Museum, but the location of all others is noted.

Part II. of the *Memoirs of the Carnegie Museum* contains a detailed description of the osteology of 'Oligocene Canidæ,' by J. B. Hatcher, including *Daphnœus felinus, Pro-*

amphicyon nebrascensis and *Protemnocyon inflatus,* the last two genera and species being new. The author has a well-timed protest against the establishing of phylogenetic relations between species widely scattered in time and distribution. There is one feature about this memoir which demands special attention, and that is the date. This paper appears not to have been distributed until February, 1903, but the date on the cover is September, 1902, an apparent antedating of four months. Mere printing is not publication; an author may print descriptions of new species by the score and stack them away in the attic, but he can not, in such a case, be considered as having published descriptions of these species. In the present instance if, prior to February, 1903, John Smith had *published* descriptions of the two new species included in this memoir, he would justly be the author of those species in spite of the date on the cover of 'Oligocene Canidæ.' And yet the bibliographer, following the title, will credit them as September, 1902. In these days of multitudinous publications it is highly important that they should be correctly dated.

THE 'Report of the Public Museum of the City of Milwaukee' for the two years ending August 31, 1900, shows steady growth of the institution, while the list of accessions testifies to the interest of the citizens. The new custodian, Mr. Henry L. Ward, expresses his desire that the museum should become a prominent educational factor in Milwaukee, and various synoptical series have been commenced with this end in view. This particular province of a local museum is very apt to be neglected and the mistaken effort made to follow along the line of great and long-established museums. A strictly educational museum, unless it be the Children's Museum of the Brooklyn Institute, has not yet been attempted and there is a fine field open here for some one. As Mr. Ward says, it is easy to make such a collection so deep and technical and the labels so long that they are their own undoing, but we should like to see a museum started with the education of the average visitor considered at the outset.

F. A. L.

BEDELL COMPOSITE TRANSMISSIONS.

PROFESSOR FREDERICK BEDELL has, for some years past, been employing the electric light and power transmission lines in telephony, communicating freely wherever those lines extend. He has recently effected an important extension of his system of 'composite' transmission, utilizing a common system of distribution for both light and power transmission and for direct or alternating currents, the latter of any desired frequency. Lighting, requiring a high frequency, and power, demanding low frequencies, the one employing a single, the other a polyphase, system, may be obtained from the same system of distributing wires. The non-interference of asynchronous currents here finds its most valuable illustration. The earlier use of such simultaneous asynchronous currents in multiple-telegraphy and in Bedell's telephony is now carried to its limit by systems of composite transmission for light and power purposes.

The Bedell system includes various methods of simultaneous transmission of direct and alternating currents or of alternating currents of different frequencies. One method permits the transmission of such currents both in the high-tension primary mains and in the low-tension secondary circuits. This arrangement gives an advantage over usual dispositions in the fact that low frequencies in the polyphase circuit insures satisfactory performance of all synchronous machinery, with low line-inductance and improved regulation of e. m. f. and a perfect balance of loads on the different phases.

With this system the motor loads may fluctuate, even to the extent of operating the circuit-breakers on the polyphase generators and system, without affecting the lighting system. The two systems of transmission may be regulated separately and independently, and it becomes practicable to adopt a higher load for each than would be ordinarily permissible. The line drop on the lighting circuit may be compensated by compounding at the generator and the power system of distribution is not limited in its applications by the necessity of considering the working of the lighting system.

In low-tension secondary distribution, the direct current from the converter being introduced at the neutral points of the two distributing-circuit coils, the passage or interruption of the current thus introduced has no effect upon the action of the alternating system. A considerable variety of distribution, in detail, has been found practicable with this system, and the outcome of its adoption is expected to be a very considerable saving in cost of line and in expense of both light and power production.* It lends itself equally to distributions in light and power systems and to simultaneous operation of arc and incandescent lamps, giving a gain, often large, in the cost of copper and of line, and simplifying the whole scheme of transmission of electrical energy to multiple forms of work.

R. H. Thurston.

BRAIN-WEIGHTS OF BROTHERS AND SISTERS.

Brain-weights of brothers and sisters are not often obtained. When Professor Joseph Leidy and his brother, Dr. Philip Leidy, died within a few hours of each other, their brains, examined under similar circumstances and by the same observer (Professor Harrison Allen), were found to weigh exactly the same, 45.5 ounces troy weight, or 1,415 grams. The more distinguished of the two, Professor Joseph Leidy, was also fourteen years older than his brother. Marchand, in his recent work on brain-weights, cites some interesting figures from Professor Kockel, who had the opportunity to remove and weigh the brains of three brothers and of a brother and two sisters. The figures follow:

A. BROTHER AND TWO SISTERS, DROWNED TOGETHER.

Boy, age 4½ years	88 cm.	1292 gms.
Girl, age 3½ years	83 "	950 "
Girl, age 2 years	67 "	960 "

B. THREE BROTHERS, SUFFOCATED BY ILLUMINATING GAS.

Boy, age 12½ years	133 cm.	1400 gms.
Boy, age 8 years	121 "	1460 "
Boy, age 4¾ years	100 "	1400 "

It may be noted in the first instance that the brain-weight of the two-year-old girl exceeds that of the older sister by 10 grams, while the brother's, who was only 5 cm. taller than the elder sister, exceeds her brain-weight by 342 grams. In the second instance the brain of the eight-year-old boy is 60 grams heavier than that of the older brother, while the latter's brain-weight is equaled by that of the youngest brother. It should be added that all three brains were exceedingly hyperæmic, the venous channels were filled with much blood, and the brain-substance generally was moist and soft. The brains of adult brothers and sisters are more desirable for comparison.

E. A. S.

*HARVARD METHOD OF TEACHING PHYSIOLOGY.**

The new method of teaching physiology proposed in the *Boston Medical and Surgical Journal,* December 29, 1898, and more fully explained in the *Philadelphia Medical Journal,* September 1, 1900, was adopted by the Harvard Medical School in 1899.

The traditional method of teaching physiology consists of a systematic course of lectures illustrated by occasional demonstrations. For thirty years or more, especially in England, this didactic teaching has been further illustrated by certain experiments performed by the students themselves. Laboratory experiments, therefore, have long been a valued part of the instruction in physiology in many universities. When the new method of teaching was introduced in the Harvard Medical School, and two hundred students worked daily in the physiological laboratories, it was said that this was only doing in a large way that which had been done in a small way for many years. The enterprise was held to be valuable because it showed that large numbers of first-year medical students could be carried simultaneously through a long series of experiments, many of which had been thought beyond their powers; it was a lesson in faith and an example of administration, but nothing more.

* For descriptions of some of these features and of illustrative distributions see *Trans. M. E. and E. E. Assoc. of Cornell University,* February 2, 1903; *Elect. World and Engineer,* February 28, 1903; *Electrical Age,* March, 1903.

* From 'Physiology at Harvard,' by W. T. Porter, second edition, January, 1903.

It will be obvious that this criticism is based upon a misapprehension. The new method is not an extension of the old. It is a fundamentally different process. The old method is chiefly didactic. The new is a systematic course of experiment and observation by the student himself. In the old the student rests upon the dictum of the professor and the text-book. In the new he relies upon the fundamental experiments done with his own hands. In the old his experiments follow the lecture and attempt to verify its statements. In the new the lecture follows his experiments and discusses them in relation to the work of other observers. In the old the stress is upon the didactic teaching. In the new the stress is upon observation. Under the old method, students in the Harvard Medical School used to ask, 'Who is the authority for that statement?' Under the new, they ask, 'What is the experimental evidence?' The old method insensibly teaches men to depend upon authority, but the new directs them to nature.

In the old method the experiments performed by the students are almost exclusively such as are quickly and easily done; for example, the simpler experiments in the physiology of muscle and of the circulation of the blood. They are intended to illustrate physiological experimentation rather than to disclose step by step the groundwork of the science of physiology.

In the new method, on the contrary, the fundamental experiments and observations which form the solid ground in every field of physiology are divided into sufficiently small groups and arranged in the most instructive sequence. With the fundamental experiment of each group are placed the accessory data. The meaning of this term will be clear from the following example. Consider the function of the roots of spinal nerves. The fundamental experiment here is Johannes Müller's well-known section and stimulation of the nerve-roots. The accessory data are such of the observations and opinions of his successors as are necessary to give a clear picture of the present state of knowledge of this subject. The student makes for himself the fundamental observation, and immediately afterward considers the accessory data provided in text-book and lecture. He proceeds systematically from the fundamental experiment and accessory data of one group to those of the next, in an ordered and logical series.

The fundamental experiment and the accessory data are taken as directly as possible from the original sources, and the reference is given in each case.

It should be observed that this new method serves for the instruction of all students, from beginners to those engaged in research. The beginner performs the fundamental experiment in each group and studies the accessory data. The advanced student performs the fundamental experiments and as many of the accessory experiments as may give him the special training he desires. The research student has before him the classical observations and the original sources of the problem he has chosen.

It should be noticed also that the new need not violently push aside the old method of instruction, but may replace it chapter by chapter as the means and the energy of the instructors shall permit.

It has been urged against the new method that there are fundamental experiments which require more time than the student can possibly give, or which are too complicated to be successfully performed by him. The number of these has certainly been much exaggerated, and is daily lessened by inventions that secure simplicity without loss of accuracy. Pending such labor-saving inventions, the experiments which consume much time may well be done by committees of students, and the results reported to the entire class, who will compare them with the account given by the original discoverers.

SCIENTIFIC NOTES AND NEWS.

THE council of the British Association for the Advancement of Science has nominated the Right Hon. Arthur James Balfour to the office of president for the Cambridge meeting in 1904. They further agreed to recommend to the association the acceptance of the invitation to South Africa for the year 1905.

Professor Koch has been elected a foreign associate to the Paris Academy of Sciences in succession to the late Rudolf Virchow.

Sir David Gill, astronomer royal at the Cape, is to direct an expedition to complete the scientific survey of Rhodesia.

Dr. Hugh M. Smith, the newly appointed deputy commissioner of fish and fisheries, has left Washington for Japan, where he will make a series of investigations into the fisheries with reference to saving the terrapin industry of the United States.

Dr. L. A. Bauer returned to Washington from Porto Rico on March 16. A series of magnetic observations was successfully carried out on the Coast Survey steamer *Blake* on her trip from Baltimore to Porto Rico; a temporary magnetic observatory was put in operation on Vieques Island, to the east of Porto Rico and on the homeward trip *via* Havana, magnetic observations were obtained at two stations in Santo Domingo and at four in Cuba.

Dr. A. E. Ortmann, now of Princeton University, has accepted the position of curator of invertebrate zoology at the Carnegie Museum, Pittsburgh. He will assume the duties of his office on July 1, and asks that thereafter all correspondence be addressed accordingly.

At a meeting of the American Geographical Society in New York on March 17, the Cullum gold medal was awarded to the Duke of the Abruzzi in recognition of his services to geography by his ascent of Mount St. Elias in 1897, and his Arctic explorations in the region of Franz Josef Land in 1899–1900. The Duke of the Abruzzi is the sixth explorer to be thus honored by the society, the previous recipients of the medal having been Commander Peary, Dr. Nansen, Sir John Murray, Dr. T. C. Mendenhall and Dr. A. Donaldson Smith.

The University of Halle has conferred a gold medal on Professor J. P. Pawlow, of St. Petersburg, for his research on digestion.

As we have reported a gold medal was presented to Professor von Esmarch, the eminent surgeon, on the occasion of his recent birthday. Medical journals state that it is now proposed to give a bronze replica of the medal to persons or societies that have distinguished themselves in the first aid or Samaritan movement, as it is called in Germany. The first medal was presented to Prince Henry of Prussia, February 14.

The Medical Club of Philadelphia will give a reception to Dr. William Osler, of the Johns Hopkins Medical School, at the Hotel Bellevue on March 27.

Professor Ira N. Hollis, who holds the chair of engineering of Harvard University, has been elected president of the Boston Society of Civil Engineers.

Professor E. Mazelle has been appointed director of the Astronomical-meteorological Observatory at Triest.

Nature states that Dr. J. W. Gregory, F.R.S., professor of geology in the University of Melbourne, has met with an accident, necessitating an operation under chloroform. He was conducting scientific investigations in Tasmania at the time, and considerable anxiety has been felt concerning him. The latest news is, however, reassuring.

Dr. George F. Barker, emeritus professor of physics at the University of Pennsylvania, lectured before the Chemical Club of Columbia University on March 19, his subject being ‘Radium.’

Sir Robert Ball began a course of three lectures at the Royal Institution on March 17, his subject being ‘Great Problems in Astronomy.’ Friday evening discourses are announced on the 20th by Professor E. A. Schäfer on the ‘Paths of Volition,’ on the 27th by Professor Herdman on the ‘Pearl Fisheries of Ceylon,’ and on April 3 by Lord Rayleigh on ‘Drops and Surface Tension.’

It is proposed in Vienna to erect a monument to the African explorer, Dr. Holub, who died last year.

A committee representing Cambridge University and the Royal Society has been formed to secure a memorial of the late Sir George Gabriel Stokes.

There will be a civil service examination on May 1 for the position of systematic agrostologist in the Bureau of Plant Industry, Department of Agriculture, at a salary of $2,000. On April 21 there will be an examination to fill a number of vacancies in the position of aid in the U. S. Coast and Geodetic Survey, at a salary of $720 per annum. The age limit is eighteen to twenty-five years.

The collection of Diptera, especially Muscidæ, made by Dr. Garry de N. Hough, of New Bedford, has lately been acquired by the University of Chicago. It is believed to contain some 20,000 specimens.

The will of Mrs. Susan Bevier gives $50,000 to the Rochester Athenæum and Mechanics' Institute. The income is to be devoted to the purchase of paintings and works of art, which are to be placed in the Bevier Memorial building.

The Michigan Academy of Sciences will hold its spring meeting at Ann Arbor on March 26, 27 and 28. There will be sections in (1) agriculture, (2) botany, (3) zoology, (4) geography and geology, (5) sanitary science and (6) science teaching.

The announcement of the Ohio State University Lake Laboratory, at Sandusky indicates increased facilities in the provision of a commodious laboratory building capable of accommodating at least one hundred students and investigators. Courses are offered in zoology, botany, entomology, ornithology and physiology, with opportunities for research work or independent investigation. The latter with no charge for use of tables and general laboratory facilities. During the last summer's session twenty-four students and investigators were enrolled, these representing fourteen different colleges and universities. A series of general lectures included the following topics: 'Physiographic Features of Sandusky Region,' by Profesor E. L. Moseley; 'The Harriman Alaskan Expedition,' by Mr. Leon J. Cole, of the U. S. Fish Commission; 'The Biological Features of the Florida Keys,' by Professor E. L. Morris, of the U. S. Department of Agriculture; 'Adaptation in Animal Life,' by the director; 'Evolution of Plants in Time,' by Professor J. H. Schaffner; 'Collecting in the Philippine Islands,' by Professor E. L. Moseley. The session for 1903 opens on June 29, and lasts six weeks, while the privileges of the laboratory are open to both students and investigators for at least two weeks longer for independent work. Announcements giving details may be obtained by addressing the director, Professor Herbert Osborn, Ohio State University, Columbus, Ohio.

The Biological Laboratory of the Brooklyn Institute of Arts and Sciences, located at Cold Spring Harbor, Long Island, will hold its next regular session for six weeks beginning Wednesday, July 1. Courses are offered in high school zoology by Dr. Davenport and Mr. Lutz, in comparative anatomy by Dr. Pratt, in invertebrate embryology by Dr. Sigerfoos, in animal bionomics and variation by Dr. Davenport, in cryptogamic botany by Dr. Johnson, in ecology by Mr. Whitford, in bacteriology by Dr. Davis, and in microscopic methods by Mrs. Davenport. Fifty students are admitted to receive instruction, the tuition fee being $25. A limited number of rooms are offered free of rental to properly qualified investigators. Application for such rooms or for further information may be made to Professor C. B. Davenport, University of Chicago.

Harvard University offers a summer course of five weeks in geological field-work in the Rocky mountain region, beginning about the first of July. The field selected includes the higher groups of mountains in southwestern Colorado. The course will be in charge of Mr. Chas. H. White, who will send a descriptive circular on application, giving dates, outfit, expenses, etc. Mr. White's address is Rotch Building, Harvard University, Cambridge, Mass.

UNIVERSITY AND EDUCATIONAL NEWS.

Purdue University has recently been the recipient of liberal treatment at the hands of its state legislature, just adjourned. By an amendment to a previously existing law,

the income of the university has been increased from a twentieth of a mill to a tenth of a mill upon the assessed value of the state. The increase is about $65,000, which brings the university's annual income from all sources considerably above $200,000. The legislature, also, made specific appropriations amounting in round numbers to $150,000, out of which is to be provided a central heating plant and a building for the department of physics.

THE daily papers publish the following letter from Mr. Andrew Carnegie to the president of Cornell University: "I have followed with anxious interest your sad plight regarding pure water. To-day I read with relief that Cornell has contracted for a filtering plant of its own. If the trustees would permit me to pay for it I shall be very grateful indeed."

HARVARD UNIVERSITY will erect as a gift from the class of 1879 and from the accumulations of athletic funds a stadium. It will cost $175,000 and seat 30,000 people.

MR. JOHN D. ROCKEFELLER has offered to give Denison College, Newark, Ohio, $60,000, if the institution will raise a like sum by January 1, 1904, for the construction of additional buildings.

DR. ELIZABETH L. McMAHON, Marion, Ohio, in her will, which has recently been filed for probate, left $8,000 to found a scholarship in Vassar College for daughters of deceased physicians.

COLBY UNIVERSITY, Maine, receives $5,000 by the will of the late Robert O. Fuller, of Cambridge, Mass.

THE University of Toronto has received subscriptions amounting to $30,000 toward a convocation hall, of which sum Mr. Chester Macy has given $5,000, and Professor and Mrs. Goldwin Smith $2,000.

MR. DAVID DAVIES, of Llandinam, has presented the University College of Wales, Aberystwyth, £20,000.

THE Council of University College, London, has resolved to institute a new grade of lecturers analogous to that of *Privatdocent* of German universities.

WILLIAM J. MOENKHAUS, assistant professor of zoology at Indiana University, known from his papers on variation in fishes, received the degree of Doctor of Philosophy at the recent convocation of the University of Chicago. The subject of his thesis is: 'The development of the hybrids between *Fundulus heteroclitus* and *Menidia notata* with especial reference to the behavior of the maternal and paternal chromatin.'

PROFESSOR JOSEPH BARRELL, Ph.D., head of the Department of Geology in Lehigh University, has accepted a position as assistant professor of structural geology in Yale University.

THE following appointments have been announced at the Massachusetts Institute of Technology: Mr. Leonard D. P. Dickinson, as assistant in electrical engineering; Mr. H. B. Litchman and Mr. Frederic W. Snow, as assistants in mining engineering and metallurgy; Mr. J. Lloyd Wayne, as assistant in mechanical engineering; Mr. Gragg Richards, as assistant in geology; Mr. Robert V. Brown, as assistant in inorganic chemistry, and Mr. George E. Bradley, as assistant in metal work.

THE Isaac Newton studentship, at Cambridge University, for the encouragement of research in astronomy, of the value of £200, has been awarded to C. M. Cama, B.A., of St. John's College, sixth wrangler, 1901. The Smith's prizemen this year are Mr. H. Knapman, Emmanuel, second wrangler 1901, and Mr. A. P. Thompson, Pembroke, fifth wrangler 1901. Mr. W. H. Jackson, Clare, bracketed third wrangler 1901, receives honorable mention.

MISS CONSTANCE JONES, vice-mistress and lecturer in moral science at Girton College, Cambridge, has been appointed to be mistress of the college in succession to Miss Welsh, resigned. Miss Jones has published a translation of Lotze's 'Mikrokosmus,' and has lately been engaged in editing the unpublished ethical lectures of the late Professor Sidgwick.

PROFESSOR JAMES SULLY has resigned the Grote chair of philosophy of mind and logic at University College, London.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 3, 1903.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*FROM HIGH SCHOOL TO COLLEGE.**

OUR system of education, as it exists today, is based on the earnest conviction of the people that American boys and girls should be compelled to go to school to get the foundation of a good education, and should have the opportunity to continue their studies in secondary schools and colleges if they so desire. It is only in the states west of us that the college and university are a part of the system of free education of the state, but here also there is such ample provision by the older colleges for free tuition for needy students that one no longer regards poverty as a barrier to the higher education.

But the college and university will always be for the few favored ones who have the time as well as the aptitude for advanced study. For the masses the high school remains the capstone of our educa-

* An address delivered at the dedication of the new buildings of the Central High School of Philadelphia, November 22, 1902.

tional fabric, and by reason of the extent and variety of its curriculum, broader indeed than the college course of fifty years ago, is not inappropriately called the 'people's college.'

The improvement of the high school, as an educational organization, has been brought about by many agencies. Physics, chemistry and biology have appropriately found a place in our schools, as they have in the lives and thoughts of all intelligent people. The progress in educational methods and in the facilities of instruction, particularly in the laboratories for practical work, has also strengthened the courses of study and brought a great intellectual stimulus into the pupils' lives.

But there has been another agency at work, outside the high school, namely, the advance in college entrance requirements, and the throwing back upon the schools studies formerly pursued in the college. Whether this was a wise measure on the part of the colleges it is now not worth while to discuss, since it is an accomplished fact; it has, at least, increased the value and dignity of the high school course to such a degree that the graduates of our best-equipped and best-manned high schools are as well prepared for their life's work as were the college graduates of the middle of the last century.

The college after having thus put upon the schools an additional year's work, has not been as liberal as it might have been in recognizing the efficiency of this work. Most of our larger eastern colleges still insist on their own entrance examinations. This makes a break in our educational system which affects unfavorably the high school course preparatory to college, inasmuch as this course is then too apt to have for its aim the successful passing of examinations rather than a serious preparation for advanced work. This is an old and much-discussed question, and I touch upon it now to assert my conviction that it is practicable to throw such safeguards around the system of certification that the diploma of graduation, accompanied by the personal statement of the principal, will become much better evidence of a boy's fitness to enter on college work than a few days' written examination can be. Entrance examinations show but little more than that a boy had or had not, on the days of examination, writing under peculiarly trying circumstances, a certain knowledge of mathematics, history, language and science. Whether or not he is likely to prove a diligent student, with tastes and aptitude for his work, the college gets no indication from the examination papers, and seems to be indifferent to these qualifications.

The western states find no difficulty in articulating the high school and college in their educational system, but in the eastern states, in addition to the supposed difficulties in this articulation, there seems to be also a feeling that the dignity of a college is better maintained by insisting on its own examinations, a notion which rests on a mistaken idea of the reason for the existence of colleges. If the time of the examination were extended, so that the college could determine by actual experience the fitness of the applicants to undertake profitably college work, there would be a rational basis for an opinion as to this fitness. Why should not all secondary school graduates, who are vouched for by the principals of these schools, be admitted and given a trial until the Christmas vacation? In other words, let the entrance examination extend over three months instead of three or more days. At the end of this period (during which there will be every incentive for the earnest boy to prove his fitness) let those who show they are unprepared, through lack of knowledge or aptitude or industry, be returned to the school

whence they came or advised to abandon a college career. This plan would not necessarily result in the overcrowding of the freshman class with poorly prepared or immature boys, for the consequence to the principal of a high school of having boys thrown back on his hands would be too serious. The character of the work which secondary schools are doing in teaching and training young men should be more fairly judged than is possible by a few days' written examination. Let us hope that some method may be devised, that this may be accomplished and the good work of the schools find more abundant recognition.

Although the high school offers an admirable preparatory course for college, this course is not its primary object, which is rather to give to boys and girls during the years of adolescence a broader view of life than they are capable of comprehending in the grammar school period, and an intellectual stimulus which shall abide with them in after life.

Many elements enter into its efficiency. The location of the school and the building itself has much to do with it. Bright, large, well-ventilated rooms and cheerful surroundings, such as these great new buildings possess, have a notable influence in promoting good teaching and quick apprehension. Its efficiency is further closely connected with the completeness of its equipment—its laboratories of chemistry, physics and biology, and its libraries. But far above its material possessions rises the teacher as the most potent influence for good work. My experience is probably not different from many other college officers, in observing that the principals of many poorly equipped schools send boys to college with a uniform stamp of high scholarship which many of the richer and better equipped schools fail to equal.

It is often said that the purpose of the school is to make good citizens by giving the pupils a sound foundation of general and useful knowledge and by guiding their young minds in the ways of truth, justice and righteousness. To the idealist in education it is character-building that should be kept in mind in all the teaching and discipline of the school. And when one reads the current educational literature he is almost led to believe that this result can be brought about by purely pedagogical methods, and that the millennium must arrive in the course of another generation. In this conception of education are we not putting on the schools the responsibility which belongs to the family, the society and the church? The instruction which we give our youth in history, civics and ethics is necessary for the intelligent citizen who wishes to do his full duty in civil life, but it does not supply the incentive to make him do his duty. This is sufficiently obvious, and yet it seems necessary to say it from time to time to tone down the rhapsodies of the theorists in education over the purposes and possibilities of public schools.

Character is the result of heredity and environment. To apportion the relative values of these influences in any case is no easy matter. If a school boy proves incorrigible it is generally attributed to heredity; if he becomes tractable, to environment—so easily do we let ourselves be persuaded as to the beneficial effect of our influence.

Three results we have a right to expect from our schools, namely, that the students shall acquire a certain amount of useful knowledge, that they shall become genuinely interested in one or more of the subjects they have been studying, and that they shall learn to think for themselves. The first can be accomplished under almost any system of teaching. Grammar, history and the descriptive sciences can be taught

like the multiplication table, and often are, but it is only when subjects are pursued with interest that they become permanently profitable. And this leads directly to the question, shall the elective system be introduced into the high schools? The answer is so far simple, that a choice must necessarily be made among the great number of subjects available, but how that choice shall be made is not so easily answered.

The most sensible solution to this much-discussed problem of high school curriculum would seem to be the selection of a certain course of study by the boy or his parents, and the prescription of the studies within the course by the faculty. The development of interest is properly made the corner stone of our modern educational system, but in our efforts to attain this end we are in danger of overlooking the fact that side by side with interest should be the consciousness of power and mastery. The latter are not acquired by following the lines of least resistance.

The likes and dislikes of a school boy should not be taken very seriously in laying out his course of study, since they are too often founded on ignorance of the real nature of the subjects he would elect or reject. The interest that is developed in a subject, as the result of hard, patient study, is of infinitely more worth than the interest which rests on a passing fancy. The former is associated with a feeling of conquest and power, and with a sense of having gotten to the bottom of things; the latter is too often an interest which is satisfied with what is on the surface.

The current drift of educational thought is towards the perfection of methods and of systems of teaching. It is one of the happy signs of the times that teachers of all grades and of all degrees of experience are trying to tell their brother and sister teachers how this and that subject should be taught. A happy sign, in that it gives evidence of the deep and absorbing interest on the part of the hosts of men and women throughout our country engaged in this noble work. And yet these sincere and devoted souls, who have their daily reward in the bright and responsive faces of their pupils, generally overlook the fact that their success is not due so much to their methods as to themselves. Teachers are born, but they can also be made, not by studying rules and routine, or by the imitation of the ways of others, but through the inspiration which comes from patient, loving service.

'The whining school boy—creeping like a snail unwillingly to school' is not unknown in our day, but sympathetic treatment and bright surroundings have done much to take the terror from the school associated only with the task and the rod. Carlyle makes his hero in Sartor Resartus say: "My teachers were hide-bound pedants without knowledge of man's nature or of boys' or of aught save the lexicons and quarterly account books. How can an inanimate mechanical gerund-grinder, the like of whom will, in a subsequent century, be manufactured at Nürnberg out of wood and leather foster the growth of anything, much more of Mind, which grows not like a vegetable (by having its roots littered with etymological compost) but like a spirit by mysterious contact of spirit; thought kindling itself at the fire of living thought? How shall he give kindling in whose inward man there is no live coal, but all is burnt out to a dead grammatical cinder? The Hinterschlag professor knew syntax enough and the human soul this much: that it had a faculty called Memory, and could be acted on through the muscular integument by appliance of birch rods."

The ideals of education, looking to the development of the whole man, find full expression in the philosophers of the six-

teenth, seventeenth and eighteenth centuries. For the attainment of these ideals private tutors stood in the place of the school teachers of our day, and education was necessarily confined to those who could afford this luxury. The ideals of to-day are not lower, but they are more difficult to attain in the class-room where the teacher has two score or more pupils at one time. It is the inevitable dilution of personal influence as classes increase in size which prevents the school of to-day from becoming the power for good it might be if the teacher's strength were not exhausted in hearing and marking recitations and maintaining order. There are not, I fear, many school boards that would appreciate the suggestion of increasing the teacher's efficiency by limiting the number of his pupils. This efficiency is in inverse proportion to the number of pupils; perhaps it might be safe to say the square of the number, so rapidly does the personal influence decrease when a limiting number is overstepped. Thus does penuriousness, combined with ignorance, on the part of city councils and of school boards, often defeat the cause which they profess to maintain.

Two tendencies are now distinctly marked in our higher education, namely, the demand of the professional schools that the baccalaureate degree shall be required for admission, and the willingness of the colleges to shorten the time in which the baccalaureate degree can be obtained. There was a time, not very long ago, when theology was the only profession for which the A.B. degree was considered necessary. Now law and medicine are demanding this preparation, and it will not be long before engineering and the related technical pursuits will claim recognition of their professional character. And on the educational horizon we see the rise of a new profession—commerce—which will doubtless in its turn demand a similar recognition.

Two influences are at work in requiring the baccalaureate degree as a preparation for law, medicine and engineering; one is to give a greater dignity to these professions, and the other is the conviction, based on experience, that narrowness in education is accompanied with a narrowness of outlook which prevents a full development of a man's powers in his special line of work. By this increased requirement we are brought to face the practical question whether there is a gain in professional equipment to compensate for the time consumed; for nearly half a lifetime may be consumed (including the apprentice years) in getting ready for life's work.

It is this question, which carries its answer with it, that has led colleges to abridge the time within which the A.B. degree can be had, some by condensing the four years' work into three, others by admitting professional studies into the last two years, and still another by deliberately casting off two years' work. The significance of the A.B. degree has been so far modified in American colleges in the last generation that it no longer implies any definite course of study. It is, therefore, meaningless for the professional schools to insist upon it as a necessary preparation for advanced work. What these schools really need, and what they should require, is satisfactory evidence that the applicant possesses the necessary knowledge and the necessary maturity to undertake profitably the work involved. It may well be that a high school graduate would prove by these tests to be better prepared to enter schools of law and medicine than many a college graduate. The faculties of the professional schools should not try to evade the responsibility which belongs to them of ascertaining by some tests the fitness of the applicants to undertake their work.

By making the possession of the A.B. degree the only test of fitness many a well-prepared man will to-day be rejected and many a poorly prepared man admitted. Should we not arrive at a conclusion satisfactory to both college and professional school if a six years' combined course should lead both to the bachelor of arts and (in the case of the law) to the bachelor of laws? Let me here quote briefly from a notable address by Mr. John H. Converse, of this city, delivered on Founder's Day at Lehigh University in 1896:

"For an institution proposing to do full university work, I would formulate a course of five or six years as might be required. For one half or more of such course let the curriculum deal, as at present, with the humanities, the sciences and all that makes for the broadest education properly so called. At a fixed period, say at the end of three years, let the student elect the professional, business or scientific course which will, as far as possible, qualify him for his proposed life work. The general course should thus eventually branch out in various directions such as theology, engineering, medicine, architecture, law, chemistry, agriculture, business, transportation. To accomplish many of these specialties to-day in connection with a college course requires six or seven years. A combined university course, such as is suggested, would, therefore, be an economy of time. It would measurably avoid duplicating some subjects which are common to both a college and a professional course. The degree finally conferred should recognize the general culture as well as the special training and would, therefore, differentiate such a curriculum from that of an ordinary professional or technical school."

This may well be called the ideal professional education, and could be entered on at the age of eighteen and completed at the age of twenty-three or twenty-four. But I still hold that graduates of our best high schools should not be denied admission to professional schools if they can prove their fitness as regards both knowledge and maturity.

The attempt to readjust our educational system in the interest of professional education meets with vigorous opposition from those who fear that it means the passing of the college, with all its good traditions and aims. I do not think their fears are likely to be realized. For a large number of those who intend to enter on professional life this shorter cut is necessary. But there will always remain a not insignificant remnant who, for love of study, will lay deep and broad the foundation of knowledge based on the humanities and on the physical sciences. The choice spirits whose lives are brightened with the finest products of ancient and modern thought and learning will always be with us to keep up the tradition of pure scholarship in our colleges and universities. And there will still be many who, having the time and means to take the lengthened course, will enter the professional schools after the full college course, and the professions will still be graced by men whose technical knowledge is based upon ripe learning and culture.

One more aspect of college and university life needs to be considered. The vital and essential part played by the lengthening of the period of infancy in the development of the human race, first pointed out by Mr. John Fiske, has been happily made use of by Dr. Nicholas Murray Butler in expounding the 'Meaning of Education.' But, it may fairly be asked, is the artificial prolongation of this period of irresponsibility, which wealth has made possible, been accompanied by increased benefits to the race? Does it not rather result in enervating than in strengthening of

power and purpose? It is a significant fact that the college graduate of the middle of the last century was about four years younger than the college graduate of to-day. Many of the great men of the nineteenth century, men whom it is our delight to honor as representing what is best and highest in private life and public service, were graduated at seventeen or eighteen years of age. Has there been a corresponding gain in maturity and in intellectual and moral force in the graduate of to-day to compensate for the additional years of study?

The American college at the beginning of the twentieth century stands for what is highest and broadest in learning and scholarship and research. Never before was such an opportunity offered to the earnest and thoughtful student, and never before has there been such a large number to avail themselves of this opportunity. The college of to-day is an infinitely greater power for usefulness in its increased facilities for instruction, both material and intellectual, than the college of fifty years ago, and yet its graduates, taken as a whole, can not be said to excel the product of the older college in intellectual force, maturity of judgment and integrity of purpose. If I am right in this assumption, may we not find the explanation in the fact that there has been grafted on to the life of the older college a new and different life, which concerns itself more with the incidental advantages of a residence at college than with those which are connected directly with study? The social features of modern college life are esteemed by many to be of greater benefit to a young man than attendance in lecture room and laboratory. From the academic atmosphere in which he lives he absorbs much that resembles, if it does not actually partake of the nature of culture, and the pastimes and sports relieve pleasantly the monotony and drudgery of the class-room. If, while enjoying these careless years, enough scholastic credits can be gained to secure the degree, the college career may be said to be crowned with a fair measure of success. It will not be denied that three or four years, such as I have depicted, may be a good thing for many a young man who has not the aptitude or the moral purpose to pursue a serious course of study. He has, it may be, acquired a certain familiarity with the amenities of life which makes him an agreeable and acceptable member of polite society.

But, let it be asked, is it fair to burden an institution of learning with young men of this kind, and thereby try the patience and tax the strength of the teachers who make up its faculties, young men whose college records show a series of failures supplemented, after many trials, with the conventional passing grades? What an amount of vigorous life and energy of the teacher would be set free and available for study and research if all the students were at least earnest in their work, and how much more efficient would be their teaching.

But more important than the effect on the teachers is the effect of this life on the student himself. Are not young men unfitting themselves for the serious business of life by acquiring the habit of putting off duty for pleasure? There is nothing in the business world—in factory, store or counting-room—corresponding to making up of deficiencies or the excusing of absences. And does not the college which makes this provision for the lazy and neglectful become a party to the demoralization of character by encouraging habits which have to be eradicated before a man can become a useful member of society?

Why should it be considered unreasonable that a college should insist that those

who come within its walls to enjoy its great privileges should, as a condition of their remaining, be required to perform their daily work to the very best of their ability? "Would you," I think I hear it said, "make prigs and pedants of our young men, and take all the joy out of their college days? Life has enough sadness and tragedy; let those days at least be bright and sunny." No true pleasure was ever taken out of life by bringing a sense of duty and responsibility into it. The tragedies of life come from the neglect of duty and from the pursuit of pleasure in which no sense of responsibility abides. The careless optimism which expresses itself in 'boys will be boys' may apply to children in the lower schools, but is demoralizing when applied to men in college.

This great training ground for the higher service should maintain a standard of robust, manly character as well as of fine scholarship if it is to be a power for good in the community. When the college shall inculcate and demand that duty must come first, then all the incidentals of college life—its social pleasures, its pastimes and its sports will take their proper place and contribute normally to the symmetrical development of the whole man.

In considering the list of distinguished men who attended this great high school in their youth—distinguished in the learned professions and as scholars, philanthropists and captains of industry, of whom the city and state and nation are proud, what conclusion can be drawn as to the part which the school played in these successful careers? I think the only answer we can give is that in any school or college the good influences exerted are in direct proportion to the opportunities afforded. The prodigality with which knowledge is disseminated in our modern high school may seem like a reckless waste from the standpoint of a school board, but it is in virtue of the availability of these great and varied resources for the pupils that its great usefulness lies. Many of the pupils pass through this wealth of opportunity unaffected by it, and the little knowledge which adheres to them will be quickly lost, notwithstanding the most cunning devices of teachers to entrap their intelligence and interest. But there will always be a goodly number whose souls will be kindled by the divine fire if the right thought come at the right moment to their unfolding minds. Why should the science of numbers kindle this fire in some minds and extinguish it in others? Why do some feel the lightning strike when certain facts in science, with the generalization drawn from them, come to their consciousness? We may study the child's mind and prescribe the appropriate mental nutriment for each stage of its development, but there will always be some who refuse to be classified and remain the despair of the psychologist.

Liberal and even lavish outlay in curriculum, in equipment and, above all, in teachers is needed, that the young minds with their diverse aptitudes and tastes shall open under the most favorable conditions, and receive from the teacher and the subject an inspiration which shall last them through life.

The opportunities in equipment and curriculum offered in this school in the first decades of its history may seem to us now very humble and restricted, but there were good teachers in those days, as the results amply prove. To-day we have a great building—a noble monument to the Philadelphia Board of Education—provided with all the aids to teaching that experience has proved valuable, and a faculty of instruction of which the city and state may well be proud—a strong, safe and scholarly president, and a live, aggressive and inspiring body of teachers. That its

power for good may be in proportion to these great resources is the prayer of thousands of alumni, whose pride in its past is their hope for its future.

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AMERICAN SOCIETY OF ZOOLOGISTS. II.

An Experimental Study of the Spawning Behavior of Lampetra wilderi: JACOB REIGHARD, University of Michigan.

An attempt was made to extend Gage's excellent account of the spawning behavior of the brook lamprey, as given in the 'Wilder Quarter Century' book. Space does not permit more than a statement of results, which were obtained under the auspices of the U. S. Fish Commission:

1. Fish were numbered and a record kept of their movements and the behavior of fish removed from the nest and then released was observed, but *no constant relation was found between individual* fish and individual nests.

2. The *location of nests is determined* not by the form or character of the bottom, but by the existence beneath or in the midst of the running water of small masses of water at rest, such as occur in depressions of the bottom or behind or in front of obstructions in the stream. Small glass plates set on edge across the stream on a perfectly level bottom have such inert masses of water above and below them and, although the plates are invisible, the lampreys build nests above and below them, and this on any sort of bottom in which there are stones large enough to serve them for attachment.

3. *Sex recognition* appears to be a reaction of the male to a reaction of the female. Males, females with eggs and spent females were marked so as to be readily distinguishable. Attached males when seized by other males at once release their hold and the two fish separate. Spent females seized when attached behave like males. Females containing eggs, if seized by males while attached, retain their hold and begin at once to 'shake.' The male reacts to this movement by throwing his tail in a loop about the body of the female and then 'shaking' with her. The shaking consists in a rapid vibration of all the body behind the branchial region.

4. The loop formed by the tail of the male is always thrown accurately into the notch between the first and second dorsals of the female. In the female at the breeding season, but not in the male, the second dorsal is œdematous and is believed to serve as a support for the tail of the male during spawning. The small anal fin found in the breeding female, but not in the male, may have the same function.

Some Experiments on the Growth of Oysters: OTTO C. GLASER, Johns Hopkins University. (Introduced by Caswell Grave.)

The occurrence of elongated oysters on the edges of marshes and reefs in waters supporting profitable beds is a well-known but puzzling fact to the culturalist who sees such different results under similar conditions.

Among the explanations given by other workers, excessive crowding seemed to the author to be the only one borne out by his observations, but to test this view more carefully a number of experiments were made.

In one, young normal oysters were subjected by imbedding in cement to lateral pressure, and exhibited after thirty days a slight elongation, and the scolloped anterior edges common in elongated oysters.

In another experiment, to find if oysters liberated from an oppressive environment would change in shape under other conditions, it was discovered that, after forty-

eight days of improved surroundings, the relation between width and length changed from fifty-three per cent. to sixty-six per cent., the width of normal oysters of the same age being seventy-nine per cent. of the length.

A third experiment, to find the limits to the recuperative power, revealed the fact that young oysters take advantage of improved conditions more rapidly than old ones. The youngest oysters in this experiment changed in sixty days in the relation of width to length from fifty per cent. to sixty-eight per cent., whereas the oldest changed only from forty-one per cent. to forty-seven. The recuperative power of the younger ones was three times that of their seniors.

These experiments show that crowding alone explains the elongation; that young elongated oysters can with profit be transplanted to artificial beds, where, under favorable conditions, they can grow to a normal maturity and become marketable.

These experiments were conducted by the North Carolina Geological Survey in cooperation with the U. S. Fish Commission Laboratory at Beaufort.

Growth of Lamprey Embryos in Nature: S. H. GAGE, Cornell University. (Read by title.)

Some Points in the Life History of the Human Warble Fly: H. B. WARD, University of Nebraska.

Movements of the Cerebro-spinal Fluid in Cryptobranchus: J. B. JOHNSTON, West Virginia University.

The cerebro-spinal fluid of *Cryptobranchus* normally contains a considerable number of red blood corpuscles which serve as a convenient means of demonstrating the course of flow of the fluid when the brain ventricles are opened, the animal being under the influence of chloretone.

There is a general current which flows backward on the floor and the lower part of the side walls of the brain, and forward along the roof and the upper part of the side walls. Subordinate circuits, each more or less complete in itself, are present in the hind-brain, in the mid- and 'tween-brains and in the fore-brain. This is especially noticeable in the mid- and 'tween-brains, where there is a distinct whirlpool of corpuscles on the lateral wall. Also on the side wall of the medulla oblongata are several small whirlpools between the upper and lower currents of the main circuit. In the lobi inferiores the directions of the main circuit are reversed, so that the current flows backward on the roof of the lobes and saccus vasculosus and forward on the floor. It is possible that the three sections of the current are related in some way to the three vascular plexuses of the brain, but it is more probable that they are due to the two chief isthmuses by which the ventricles are divided into three parts.

The corpuscles have the appearance of being driven by cilia. The fact that the current is kept up after the brain is opened, and that the corpuscles are driven against the force of gravity when the brain is tilted, and the formation of whirlpools are scarcely to be explained in any other way. No such long flagella as are seen in the brain of *Acipenser,* nor any special ciliated tracts such as have been described for other forms, have been found, but apparently the whole floor and part of the side walls of the brain ventricles are covered with very fine cilia.

On the Negative and Positive Phototropism of the Earthworm Allolobophora fœtida (Sav.) *as Determined by Light of Different Intensities:* G. P. ADAMS. (Presented by G. H. Parker.)

Allolobophora fœtida is negatively phototropic toward light from electric incan-

descent lamps varying in intensity from 192 candle-meters to .012 candle-meter; the percentages of negative head movements referable to light of different intensities are as follows: 41.5 per cent. (192 cm.), 41.5 per cent. (90 cm.), 59 per cent. (48 cm.), 45 per cent. (31 cm.), 45.5 per cent. (12 cm.), 38.5 per cent. (5 cm.), 24.5 per cent. (1 cm.), 14 per cent. (.128 cm.), 12 per cent. (.050 cm.), 5 per cent. (.020 cm.), and 3 per cent. (.012 cm.). *A. fœtida* is positively phototropic toward an electric incandescent light of .001 candle-meter intensity. Earthworms retreat into their burrows during daytime because of their negative phototropism. They emerge at night not so much because of darkness, but because of their positive phototropism for faint light.

The Collembola Fauna of Cold Spring Harbor Beach: C. B. DAVENPORT, University of Chicago.

The apparently lifeless surface of the between-tide zone of this sandy beach supports a vast host of minute insects belonging to the family Poduridæ. These animals crawl out to the surface after the retreat of the tide and return again into the sand as the tide rises. The period which they spend on the surface is spent in ceaseless activity, and the direction of all this complex movement is determined by the resultant of the physical agents by which they are surrounded. They are geotactic, hydrotactic, rheotactic, thigmotactic and phototactic in the highest degree. This extreme sensitiveness of organisms closely related to the ancestors of insects is suggestive in view of the complex nervous mechanism and reactions attained by their most highly developed descendants.

The Function of the Pearl Organs of the Cyprinidæ: JACOB REIGHARD, University of Michigan.

Pearl organs are found in the breeding males of many fish, but only rarely in the females. The breeding behavior of three forms was studied, *Campostoma anomalum, Rhinichthys atronasus* and *Semotilus atromaculatus.*

The organs in all these cases are spines and in each case they were found to have a mechanical function. They are used in *Campostoma* in building the nest, in the battles of the males and in holding the females during the act of spawning. In *Semotilus* and *Rhinichthys* they are used in holding the spawning female. The method of holding the females is different in each of these three cases, but in each case the distribution of the pearl organs corresponds to this mechanical use.

Phototaxis in Volvox: S. J. HOLMES, University of Michigan.

In light of weak or moderate intensity *Volvox* is positively phototactic and orients itself very accurately to the direction of the rays. In swimming towards the light the anterior end of the organism is directed forwards, the body rotates on its longer axis, and deviates remarkably little from a perfectly straight course. In very strong light *Volvox* becomes negatively phototactic, swimming away from the light in very nearly a straight line. The grouping of *Volvox* in places of a certain intensity of illumination is a natural consequence of the fact that this organism is positively phototactic in weak light and negatively so in strong light. In very dim light *Volvox* shows no pronounced phototaxis, and either lies quiet or rolls about in a slow and irregular manner. In moving towards the source of light the rate of locomotion, within certain limits, increases with increase in the intensity of illumination, but, as the optimum is approached, the speed becomes gradually less. In swimming away from strong light the speed is likewise lessened as the optimum

is approached from the other side. It is difficult to explain the orientation of *Volvox* on the theory that it is brought about by differences in the intensity of illumination on the two sides of the organism. According to this view, we should expect that as *Volvox* passes from weak into stronger light its rate of speed would be decreased, but this does not occur. The explanation of orientation in this form is not so simple a matter as it might seem.

The Blood Flow and the Structure of the Vessels in the Earthworm: J. B. Johnston and Sarah W. Johnson.

We have previously reported the results of an experimental study of the course of the blood flow in *Lumbricus*, which showed that the circulation in this worm is not segmental, but strictly systemic. This view of the circulation opened two lines of further inquiry: What happens when the hearts are removed from the circulation by cutting off the head segments of the worm; and what is there in the structure of the blood vessels to determine the course of blood flow? A series of regeneration experiments and the study of the histology of the blood vessels have given striking confirmation of our previous conclusions.

1. In all animals from which the head segments were removed there was an enormous collection of blood in the anterior end of the worm, including the regenerated segments. Such a condition would probably not be brought about if there were a segmental circulation in the normal worm. Usually all circular vessels were crowded, but the intestinal vessels and spaces were more distended than the parietal vessels.

2. The dorsal vessel and all the vessels connected with it are provided with valves which determine the direction of the blood flow. In the dorsal vessel at the level of each septum is a pair of large, thick, flap-like valves, one attached to either lateral wall of the vessel. These valves open forward and are closed at the time of each contraction-wave. The parietal, dorso-intestinal and dorso-typhlosolar vessels are each provided with similar valves, so placed in the mouth of each vessel that the blood can flow freely into the dorsal vessel, while each vessel is closed by its valves in advance of the contraction-wave of the dorsal vessel. No valves have been found in any other vessels, but these are enough to direct the blood flow.

3. The walls of the vessels are made up of three coats: (*a*) A layer of extremely thin, flat, endothelial cells; (*b*) a connective tissue membrane containing longitudinal fibers, probably muscular; (*c*) a layer of circular muscle fibers. The valves are masses of cells connected with the connective tissue layer. The circular muscle layer is especially thickened at the valves in the dorsal and parietal vessels, and the contraction of these bands of muscle presses the valves together, completely closing the vessels. A similar mechanism in the intestinal and typhlosolar vessels has not been seen, but the valves are so placed as to open toward the dorsal vessel and to be closed by backward pressure.

On Phyllodistomum americanum n. sp., a parasite in the Urinary Bladder of Amblystoma tigrinum Green, in Minnesota: Henry Leslie Osborn, Hamline University.

This genus, recently founded by Braun,* has been reported from central Europe, eastern Asia and northeastern Africa, from the urinary bladders of fish and amphibia,† but has not hitherto been recognized in this hemisphere. I have found that flukes generically identical with the old world ones,

* 'Ueber Clinostomum,' *Zool. Anzeig.*, XXII., pp. 484–488, 1900.

† Looss, 94, *Distom. Fisch. u. Frosch;* Sturgis, 97, *Zool. Bulletin*, I., p. 57; Odhner, '00, *Cent. F. Bakt. u. Parasit.*, XXXI., pp. 58–69.

but specifically distinct, occur in the urinary bladder of a salamander, *Amblystoma tigrinum* Green, which is found frequently in the district near Saint Paul, Minn. The number of the parasites found in a single host is not large (two to ten and this in only six out of twenty-nine salamanders examined). The total length of the largest specimen of the parasite thus far seen is 3.5 mm., its greatest width 1.4 mm. or 40 per cent. of the length. It is thus much narrower than any of the old world forms, *P. patellare* having this ratio, 66 per cent., *P. spatula* (Odhner, '00) 63 per cent. and *P. folium* 48 per cent. One of Odhner's species, *P. unicum*, has a width of 43 per cent. of the length, according to his figures. The testes in the American form are both completely posterior to the ovary, and nearly in line one in front of the other. The testes, ovary and vitellaria are all deeply lobed. This is unlike *P. unicum*, which resembles this species in its proportions, but in which the genital organs are said to be entire or nearly so. The course of the uterus is characteristic: next the ootype there is, first on the left side a loop forward, then one backward and behind the posterior testis, then one in front of this and behind the anterior testis, then another in front of the anterior testis, then crossing to the right side in front of the ovary, first an anterior loop and then a posterior loop. This is unlike either *P. folium* or *P. patellare*. A fuller account of the anatomy of this species is in process of preparation; the name is given in view of its being the first species of the genus to be reported from this country.

On Cryptogonimus chyli, n. g., n. sp., a Trematode from Lake Chautauqua, N. Y., with Novel Type of Ventral Sucker: HENRY LESLIE OSBORN, Hamline University.

A very small distomid fluke (0.5–1.3 mm. in length) of decidedly aberrant structure occurs abundantly in the chyle of the black bass (*Micropterus dolomieu*) of Lake Chautauqua, New York, and in the St. Mary's River near Sault Sainte Marie, Mich. The body is cylindrical, obtusely tapering posteriorly, is covered with broad flat scales and has a large oral sucker. About the front end of the middle third of the body there is, mid-ventrally, a peculiar and unique sheath, with circular lip and sphincter muscle enclosing a chamber in which are located two entirely disconnected ventral suckers, one behind the other, with the genital pore located in the middle line between them and wholly separate from either. There is a pharynx, a very short œsophagus, the intestines reach only to the beginning of the hinder third of the body, there are two conspicuous masses of pigment (but no lenses) on either side of the pharynx, seemingly rudiments of eyes. The excretory pore is terminal, there is a large median bladder in the hinder third of the body, and a large fork from it on each side running forward to the level of the pharynx, forming there a large conspicuous hollow cavity on each side. The spermaries are oblique and near the beginning of the hinder third of the body. The ovary is near the level of the anterior spermary, the uterus passes posteriorly to the extreme end of the body, returns on the opposite side black in color from the multitudes of ova, crosses to the right side and runs to the surface, crossing over the posterior ventral sucker in its course, and joining the ductus ejaculatorius to form a very short muscular genital sinus. The vitellaria consists of a number of distinct follicles in a row laterally in the middle third of the body. A Laurer's canal or seminal receptacle seems to be present in the form of a tube connected with the oviduct near the junction of the yolk ducts, but it lacks a

communication with the exterior. There is a large seminal vesicle, but no sac; prostate cells are present, collected around the passage from the seminal vesicle to the exterior. They are not shut off by a membrane from the surrounding parenchyma. I have not as yet reached any conclusion as to the affinities of this form with the other distomids.

Some Recent Additions to the Marine Fauna of Bermuda: C. L. Bristol, New York University.

Distribution of Fresh-water Fishes in Mexico: S. E. Meek, Field Columbian Museum.

A Comparison of the Plankton of Green Lake and Lake Winnebago: C. D. Marsh, Ripon College.

These lakes represent the two types of deep and shallow lakes. Plankton collections were made upon them regularly for a period of two years and a half. From these collections records were made of the annual distribution of the total plankton and of the principal constituents of the plankton. For comparison a number of other lakes were visited at different periods, but upon them no continuous record was kept. The attempt was, first, to accumulate a certain number of facts in regard to the plankton, and then, second, if possible, determine some of the fundamental principles controlling the distribution of the plankton and its constituents. The distribution of the total plankton was discussed briefly, and then an account was given of the annual distribution of two or three of the more important individuals composing the plankton. Attention was called to certain interesting relations between the occurrence of species and temperature, and then the question of the balance between animal and vegetable organisms was discussed at some length.

A Combined Locker and Laboratory Table: Pierre A. Fish, Laboratory of Comparative Physiology and Pharmacology, N. Y. State Veterinary College, Ithaca, N. Y. (To be published, with illustrations, in *Journal of Applied Microscopy.*)

Specifications.—Both sides of the table are to be exactly alike. Each table will then have four doors, four drawers, each five inches deep in the clear, and eight drawers each three inches deep in the clear.

Exterior of tables and fronts of drawers are to be of selected red oak; drawer guides or slides of oak, maple or cherry; and balance of interior work of poplar.

Each door shall be hung with one pair good brass fast pin butts, and shall be fitted with an 'anti-dial' combination lock. Each table shall be fitted with eight 'standard' No. 7, all steel castors.

Except the top, all exposed work, including drawer fronts, shall be filled with silica paste filler, and shall then be finished with one coat of white shellac and one coat of Johnson's, or equally good, wax. Inside and drawers, except fronts, shall have one coat of orange shellac.

The table in question was designed for laboratory work in physiology and materia medica. The height and also the area of the table top is somewhat greater than ordinary for the reason that, in experimental physiology, it is necessary at times to have considerable apparatus upon the table, and the height is desirable because in some experiments the student can do his work better standing than sitting. The foot rest attached to the tables, in connection with a stool a trifle higher than usual (twenty-four inches), enables the table to be perfectly serviceable and entirely satisfactory for all forms of work at which it is desirable that the student should sit.

The chief advantage of the table, however, is believed to rest upon the fact that a considerable economy of space and con-

venience to the worker is subserved. The floor space covered by the table in many instances is not utilized at all, except for the work done upon the top of the table. Lockers, when necessary, have been built along the walls of the laboratory or in the hallway or in an adjoining room, thus taking up space which might be profitably utilized by wall cases containing specimens, models or general apparatus bearing upon the laboratory course. Students often pass to and fro from table to locker, causing more or less jar and vibration, especially annoying if microscopical work is going on. Such an arrangement is doubly inconvenient. It is annoying to the student to be obliged to go from table to locker. It is also annoying to his fellow workers to have him do so.

The combined lockers and table obviates these disadvantages. Each table contains four lockers, and two students can work at one table and have their apparatus right at hand. Twelve tables will provide lockers for forty-eight students, and twenty-four students can work at the tables at one time.

The table would appear to be useful for biological work in general, although in certain cases a proportionate change in dimensions may be desirable.

The cost of the combined locker-table is less than the total cost of a table and four lockers built separately. In lots of one dozen, the combined locker-table, including a combination lock for each locker, can be built in red oak for fourteen dollars each, or in chestnut for twelve dollars each. The writer has used these tables for nearly two years and has found them satisfactory in every way.

An Acid-proof Table Top: Pierre A. Fish, Laboratory of Comparative Physiology and Pharmacology, N. Y. State Veterinary College, Ithaca, N. Y.

Three or four years ago the writer saw in a pharmaceutical journal (*Merck's Report*) a formula for a black finish for table tops. The article did not give the author's name nor the original source of the formula, but stated that the method was 'used abroad.' Further acknowledgment can not, therefore, be made. The formula was as follows:

1.

Copper sulphate	1 part.
Potassium chlorate	1 "
Water	8 parts.

Boiled until salts are dissolved.

2.

Aniline hydrochlorate	3 parts.
Water	20 "
Or if more readily procurable:	
Aniline	6 "
Hydrochloric acid	9 "
Water	50 "

By the use of a brush two coats of solution No. 1 are applied while hot, the second coat as soon as the first is dry; then two coats of solution No. 2, and the wood allowed to dry thoroughly. Later a coat of raw linseed oil is to be applied, using a cloth instead of a brush in order to get a thinner coat of the oil.

The writer used this method upon some old laboratory tables which had been finished in the usual way, the wood having been filled, oiled and varnished. After scraping off the finish down to the wood the solutions were applied, and the result was very satisfactory.

After some experimentation the formula was modified without materially affecting the cost and apparently increasing the resistance of the wood to the action of strong acids and alkalies. The modified formula follows:

1.

Iron sulphate	4 parts.
Copper sulphate	4 "
Potassium permanganate	8 "
Water	q. s. 100 "

2.

Aniline	12	parts.
Hydrochloric acid	18	"
Water q. s.	100	"
or		
Aniline hydrochlorate	15	"
Water q. s.	100	"

Solution 2 has not been changed except to arrange the parts per hundred.

The method of application is the same except that after solution No. 1 has dried, the excess of the solution which has dried upon the surface of the wood is thoroughly rubbed off before the application of solution No. 2. The black color does not appear at once, but usually requires a few hours before becoming ebony black. The linseed oil may be diluted with turpentine without disadvantage, and after a few applications the surface will take on a dull and not displeasing polish. The table tops are easily cleaned by washing with water or suds after a course of work is completed, and the application of another coat of oil puts them in excellent order for another course of work.

Strong acids or alkalies when spilled, if soon wiped off, have scarcely a perceptible effect.

A slate or tile top is expensive not only in its original cost, but also as a destroyer of glassware. Wood tops when painted, oiled or paraffined, have objectionable features, the latter especially in warm weather. Old table tops, after the paint or oil is scraped off down to the wood, take the finish nearly as well as the new wood.

A Useful Light for Biological Laboratories: E. A. Andrews, Johns Hopkins University.

Experiments at the seashore and in this laboratory show that acetylene lamps have some advantages over other artificial lights for use with the microscope when good daylight is not available. These are: less irritating character of the light, greater whiteness, that enables color to be justly judged, and portability. With these is joined an intensity sufficient for use with Zeiss 18-ocular and 2-mm. objective.

The Welsbach light with Eisen's color screens* gives excellent results, but the aniline screens are troublesome, the mantles fragile and a gas supply not everywhere available.

The electric lamps as used by Metcalf† are exceedingly convenient, but less powerful and less white than the acetylene lamp.

Some of the better acetylene bicycle lamps give good results for the individual worker; but, till the market be supplied with a lamp specialized for our purposes, the best lamp for individual and for class use seems to be the acetylene lamp known as the 'Electrolite.' To adapt this to microscopic work we add a 'bobeche' as used for Welsbach lights, made of finely ground imported glass. There is also added an opaque shade, instead of a globe, large enough to restrict the light to the area of the table in use. All the light used passes through the ground glass and is diffused.

For use with high powers and vertical stand the too tall lamp may be placed lower than the work table. On the other hand, for a class using low powers the tall stand will spread the light, so that ten or twelve using Zeiss D and ocular 2 may work around one lamp if the tables are properly placed.

The objection to acetylene lamps is the trouble of attending to them, but in the 'Electrolite' filling and cleaning are not difficult, and with one charge of carbide the lamp may be put out and relighted at any time till more than ten hours of actual burning have passed. Acetylene for microscopic work has been commended

* *Zeit f. wiss. Mik.*, 1897.

† Science, 1901.

by the Canadian pathologist, Chas. H. Higgins.*

A New Method of Embedding Small Objects: GEORGE LEFEVRE, University of Missouri.

A special form of watch-glass was described which obviates the usual difficulties encountered in embedding loose, minute objects like echinoderm eggs.

The dish is a flat, solid watch-glass, containing a shallow concavity, in the bottom of which is molded a narrow, slot-like groove or trough.

The objects, after saturation with the solvent, are transferred to the dish, filled with melted paraffin and kept warm on the bath, by carefully dropping them from a pipette into the groove, where, owing to the confined space, they will remain closely massed. The bottom of the dish is then rapidly cooled on the surface of water, and the paraffin, when thoroughly hardened, may be removed without difficulty. The objects are held in the portion of the paraffin which previously filled the groove and which now projects from the surface of the block. The block is then attached to the paraffin-holder of the microtome, and the objects are ready for sectioning.

The practical usefulness of this dish has been thoroughly tested, and experience has shown that it may be manipulated so easily and conveniently that the embedding in it of such minute objects as it is intended for becomes as simple an operation as the embedding of larger ones which may be handled individually.

In addition to its use as described above, the dish is serviceable for the purpose of orientation. A small object lying in the groove may be rapidly oriented with a warm needle under the microscope and placed in any desired position. It is then possible to cool the paraffin without disturbing the object.

* *Acetylene Gas Journal*, 1901.

The Heredity of Sex: W. E. CASTLE, Harvard University. Presented by title. (Published in full in *Bulletin Mus. Comp. Zool., Harvard College.*)

1. Sex is an attribute of every egg and spermatozoon. It is independent of environment, and is inherited in accordance either with Mendel's law of heredity or with the principle of mosaic inheritance.

2. Mendel's law includes (*a*) the principle of *dominance* in the zygote of one of two alternative characters over the other, and (*b*) the principle of *segregation* of those characters at the formation of gametes.

3. In *mosaic* individuals alternative characters coexist without dominance of either; they pass together (*without segregation*) into the gametes.

4. Mendel's law governs the heredity of sex among diœcious animals and plants; but hermaphroditic organisms are sex-mosaics, and form only mosaic gametes.

5. In diœcious organisms, (*a*) one sex dominates, the other is latent; (*b*) each gamete bears the characters of one sex only, but can unite in fertilization only with a gamete bearing the characters of the *opposite* sex; (*c*) in the zygote sometimes the male character dominates, sometimes the female.

6. In parthenogenetic animals the female character invariably dominates over the male when both are present together. In such animals, (*a*) all fertilized eggs are female; (*b*) unfertilized eggs produced without segregation of sex-characters are female; (*c*) males develop only from unfertilized eggs *from which the female character has been eliminated.*

7. The female character eliminated from the male parthenogenetic egg passes into the testis; hence the spermatozoa of parthenogenetic animals are female (example, honey-bee).

8. Sex-characters segregate at the second (the 'reduction') maturation division. For eggs which develop without fertilization and without a second maturation division contain both the male and the female characters, the former recessive, the latter dominant. But, in normally parthenogenetic species, eggs which undergo a second maturation division and then develop without fertilization are always male. In such species the female character regularly passes from the egg into the second polar cell; in diœcious animals *either* sex-character may remain in the egg.

Gilman A. Drew,
Secretary (Eastern Branch).
University of Maine.

SCIENTIFIC BOOKS.

Die Biogenhypothese. Eine kritisch-experimentelle Studie über die Vorgänge in der lebendigen Substanz. By Max Verworn. Jena, Gustav Fischer. 1903. 8vo. Pp. 114.

To consolidate the ideas which are presenting themselves more or less obtrusively to the minds of all workers in the biological sciences, and to give them concrete expression, is an accomplishment of no little importance, and it is this which Professor Verworn has attempted in propounding his Biogen-theory. Biogen is the special constituent of protoplasm whose decomposition and recomposition are the basis of the phenomena which we recognize as life, and the paper now under review is an examination into the nature of vital phenomena and an endeavor to deduce from this examination what the general composition and structure of the biogen molecules must be.

In its essence Verworn's theory differs but slightly from that advanced by Pflüger many years ago; it does differ, however, in its details. For it recognizes the similarity of the chemical processes taking place in the cell to those manifested during the action of an enzyme, accepting the prevalent view that an enzyme acts as a catalyzing agent and that the action of a catalyzer is the formation of a labile intermediate product which instantly decomposes, restoring the catalyzer to its original condition. Enzymes exist in the living substance which are capable of bringing about complicated syntheses and have the power of producing by their activity additional quantities of themselves; such phenomena demand the assumption that even in the molecules of the enzyme metabolism occurs and the biogen molecule may be regarded as something similar to such an enzyme.

Assuming this idea as a foundation, what may be predicated concerning the special composition of the biogen molecule? It is well known that an increase in the amount of oxygen increases, and a diminution of it diminishes, the irritability of the living substance, and Professor Verworn believes that it has been established by his own observations and those of his pupils on strychninized frogs that this phenomenon depends upon an increase in the lability of the biogen molecules in the presence of oxygen, and a diminution of it in the absence of that substance. If this be true, then it may be assumed that there is in the biogen molecule a chemical group which reacts readily with oxygen, and, since the functional activity of muscle, for instance, is associated, as Hermann demonstrated long ago, with the formation of non-nitrogenous products of decomposition, it may be supposed that the reacting group is a carbohydrate group, or, perhaps, on account of its affinity for oxygen, a carbon group of the type of a carbohydrate with a terminal aldehyde group.

But in addition there must also be a nitrogenous group in the molecule, since a continuous nitrogenous catabolism is going on in the tissues, and that this group is probably of the benzol type is shown by the formation of aromatic decomposition products, such as tyrosin, indol, phenol, skatol, etc., as the result of the digestion or putrefaction of albumen compounds. For the building up of a complicated organic compound a benzol group presents many possibilities, and Verworn supposes that such a group forms the center of a biogen molecule and that the carbohydrate

group is a side chain associated with it. Further, he supposes that the central group has attached to it another side chain which acts as the receiver and transmitter of the oxygen, and consists of a nitrogenous or iron compound, since certain compounds of either of these elements readily combine with oxygen and yield it up again. A biogen molecule may, then, be pictured as composed of an oxygen receptor and translator, consisting of a nitrogen or iron group, and oxidation material represented by a carbohydrate group with certain aldehyde-like peculiarities, both these groups being united as side chains to a benzol nucleus.

In such a molecule two varieties of destructive change may occur: what may be termed functional dissociation, affecting only the carbohydrate side chain, and destructive decomposition, which affects the entire molecule. The latter process necessarily impairs or destroys the activity of the molecule, and is compensated for by the synthetizing powers of the unaltered biogens which, acting on the products of digestion, build up additional molecules by a process of polymerization.

It is believed that there is no evidence of the existence of biogens in the cell nucleus, although this structure, directly or indirectly, contributes to the maintenance of the metabolism of the cytoplasm. The active molecules are located exclusively in the cytoplasm, which also contains reserve supplies of nutrition and of oxygen, the latter being in composition, and it is also supposed that there is present normally a greater or less amount of material, produced by the action of the cell enzymes, and of such a nature that it can at once be employed in the restitution of the biogen molecules.

Such is, in outline, the biogen theory, and having expounded it, Professor Verworn proceeds to apply it to the explanation of certain physiological phenomena. He points out that two changes may be recognized as causes in the diminishment of a response to stimuli: (1) A diminution or suppression of the lability of the molecules and (2) a diminution or suppression of the supply of restitution material. The characteristic symptom of the first of these causes is a gradual rise in strength of the minimal stimulus during the development of the phenomenon, while that of the second is the occurrence during its development of constantly increasing intervals during which the tissue fails to respond to the stimulus. On this basis a distinction, already drawn on somewhat similar lines by an American physiologist, is made between *fatigue* and *exhaustion*, the latter being regarded as due to the imperfect restitution of the molecules, while the former is the result of an impairment of their lability, owing to an accumulation in the tissues of catabolic substances which act as narcotics. For it is claimed that the effect of narcotics in general is an inhibition of the lability of the biogens.

It would carry us too far to follow the author into his application of the theory to the explanation of the phenomena of the self-regulation of metabolism, of rhythm and of the source of muscular energy. Suffice it to say that these subjects are treated with the same clearness and suggestiveness as distinguish the remainder of the paper. Professor Verworn is careful to insist that his theory claims merely the rank of a working hypothesis, and, viewed in this light, it should serve a purpose in stimulating further investigation. Its similarity to Pflüger's hypothesis has been already noted; indeed, it might be characterized as Pflüger's theory expressed with greater precision and combined with an idea borrowed from Ehrlich's well-known theory of immunity. One may question the advisability of substituting the single chemical compound biogen for the more complex protoplasm as the material basis of vital energy, and it may be claimed that the assumed structure of the biogen molecule is altogether too schematic; but, nevertheless, it will be admitted that the paper is full of interest and suggestion, and even though the future may show the theory to be futile, it must be remembered, as the author points out, that 'for the development of human intellectual life a fertile error has infinitely greater value than an unfertile fact.'

J. P. McM.

Results of Observations with the Zenith Telescope of the Flower Astronomical Observatory—from September 6, 1898, to August 30, 1901. By Charles L. Doolittle.

This is fourth in the series of publications by Professor Doolittle of observations of latitude. The first two contained observations from April 1, 1876, to August 19, 1895, made at the Sayre Observatory, Bethlehem, Pa.; and the last two, from October 1, 1896, to August 30, 1901, at the Flower Observatory of the University of Pennsylvania.

This series is of exceptional value as being the earliest, as well as the most prolonged, thus far made in the investigation of latitude variations. It was begun seven years before the first proposal by Fergola at the session of the International Geodetic Association in Rome, that there should be an observational test of the constancy of latitudes, and eight years before Küstner began his observations whereby the discovery of variation was first boldly announced as proved. From that beginning, the series has continued, though with some interruptions, until to-day. The charts accompanying these four publications therefore show nearly a continuous curve from December, 1889, to September, 1901. Sections earlier than 1889 may be platted from the data given. The precision of the observations is shown by a progressively diminishing probable error for a single determination of latitude ranging from ± 0″.578 at the start with an inferior 'second-hand' instrument, to ± 0″.134 at present, with a superior instrument of Warner & Swasey's construction.

Possessing fully as much interest as the latitude curve, are the seven values of the aberration constant, simultaneously deduced as a by-product from the same observations, viz.,

1889, Dec. 1, to 1890, Dec 13..	″ 20.448	± 0.014	¼
1892, Oct. 10, to 1893, Dec. 27.	20.551	.009	1
1894, Jan. 19, to 1895, Aug. 19.	20.537	.014	1
1896, Oct. 1, to 1898, Aug. 16..	20.580	.008	½
1898, Sept. 6, to 1899, Nov. 27..	20.540	.010	1
1900, May 5, to 1901, Aug. 30..	20.561	.008	1
1901, Oct. 1, to 1902, Aug. 18..	20.510		1

The last value is a preliminary determination announced previous to publication of the observations on which it depends. The mean of these values is 20″.539, which differs only 0″.016 from the mean of all determinations thus far made by all methods included in Dr. Chandler's discussion of this value (*A. J.* 529, 530), namely 20″.523.

In view of the high degree of accuracy now attained in these observations and the prolonged period of time over which a single observer has already extended them, though beset with singular difficulties, particularly in the earlier portions of the series, it is a cause for gratification that this fourth publication does not mark the termination of Professor Doolittle's work. It is still in progress, and astronomers may confidently expect the publication of a fifth part, from August 30, 1901, onwards.

Herman S. Davis.

A Treatise on Roads and Pavements. By Ira Osborn Baker, C.E., Professor of Civil Engineering, University of Illinois, etc. First edition, first thousand. New York, John Wiley and Sons; London, Chapman and Hall, limited. 1903.

According to the preface, 'the object of this book is to give a discussion, from the point of view of the engineer, of the principles involved in the construction of country roads and city pavements.'

From this point of view we believe the work of the author extremely well done. We also believe that enough new matter and new ideas have been introduced fully to warrant this addition to the already large number of similar works devoted to this general subject.

Especially admirable is the arrangement of chapters and of articles under the chapters. This arrangement gives the table of contents unusual value, enabling the reader at a glance to observe both the presence and absence of the matter sought.

While almost every possible subject is present, we note with some surprise the absence of any detailed discussion of cements, although the use of cements in concretes and concrete foundations and for other minor

purposes in road-making is fully treated. We presume the chemistry and technology of cements have been fully treated in other works by the same author; but we think the omission in the present work of this subject has been a mistake, as many problems in road construction depend for their successful solution upon a thorough and discriminating knowledge of the nature and quality of the cements that are upon the market.

Another defect of the work of a more serious nature, arises from the attempt of an engineer to discuss problems that do not pertain to engineering. We refer to the entire discussion of the subjects embraced in Chapter XIII. This work is published in 1903, yet a careful examination of the entire chapter fails to disclose anything more recent than about two years, and most of it is ten years old. The chapter is evidently written up 'from the book,' instead of from actual experience and personal knowledge; hence the discussion proceeds without discrimination.

It is not to be expected that an author will discuss all subjects equally well; but it is to be regretted that in a work furnishing in other respects so much material of permanent value, this important subject of asphalt pavement should be discussed in such a manner as to be often misleading and generally of but little worth.

While the work will greatly aid the builders of city streets, we believe it will especially commend itself to that larger body of intelligent men who are at this time interested in the improvement of country roads, and to them we commend its careful perusal.

S. F. PECKHAM.

SCIENTIFIC JOURNALS AND ARTICLES.

THE March number of the *Biological Bulletin*, Volume IV., No. 4, contains the following papers:

W. M. WHEELER and J. F. MCCLENDON: 'Dimorphic Queens in an American Ant (*Lasius latipes* Walsh).'

RALPH S. LILLIE: 'Fusion of Blastomeres and Nuclear Division without Cell-division in Solutions of Non-electrolytes.'

CHARLES T. BRUES: 'The Structure and Significance of Vestigial Wings among Insects.'

S. J. HOLMES: 'Death-Feigning in Terrestrial Amphipods.'

EDMUND B. WILSON: 'Notes on the Reversal of Asymmetry in the Regeneration of the Chelae in *Alpheus heterochelis*.'

FLORENCE PEEBLES: 'A Preliminary Note on the Position of the Primitive Streak, and its Relation to the Embryo of the Chick.'

THE principal contents of the *National Geographic Magazine* for March include 'The Canadian Boundary,' by John W. Foster, ex-Secretary of State (a review of the methods by which the line has been adjusted and marked); 'Mountains of Unimak Island, Alaska,' by Ferdinand Westdahl; 'Opening of the Alaskan Territory,' by Harrington Emerson; 'The Forests of Canada,' 'Work in the Far South,' 'The Development of Cuba,' 'Theories of Volcanic Action.' Geographic notes and literature.

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 139th meeting of the society, held in the assembly hall of the Cosmos Club, Wednesday evening, February 25, 1903, an important discussion on the 'Genetic Classification of Ore Deposits,' begun on January 14, was continued.

Mr. Emmons, in opening the discussion, remarked that the classification of ore deposits on a purely genetic basis had been proposed, not as a practical classification, or one that could at the present day be anything more than tentative, but mainly for the purpose of bringing out the theoretical views to which various workers had arrived as the result of their studies. It seemed, therefore, important to distinguish what was purely speculative from what had actually been demonstrated. Messrs. Weed and Spurr, who had opened the discussion, ascribed an importance to igneous agencies which probably would not be admitted by a large class of workers in the field, especially as applied to certain deposits given as types of one or the other of their classes. This application seemed based on speculation rather than on actual demonstration. The important question seemed to be the capability of igneous magmas to supply

the amount of water necessary for the formation of ore deposits as they are found in nature. Professor Kemp has been a strong advocate of the affirmative side of this question.

Professor J. F. Kemp, continuing the discussion, said: "In the establishment of types of ore deposits we should seek certainties as much as possible, and avoid cases which admit of difference in interpretation. If we use source and method of introduction of material as a fundamental principle, we shall do well in doubtful cases to fall back on points of geological structure, since, regarding the facts of the latter, there can seldom arise uncertainty. As well-established types we have at one extreme magmatic segregation from igneous magmas; at the other extreme, placers and residual concentrates produced by water. Starting now with contact deposits, produced especially by the action of eruptives on limestone and from pegmatites, which are assured after-births of vulcanism, we may proceed through the various types of ore bodies to an extreme produced by meteoric waters. Mr. Weed has done a valued service in emphasizing the igneous causes, and surely no one who appreciates the huge garnet zones and the amount of silica contributed to them by the eruptive, can fail to see in the eruptive itself a rich source of quartz for veins. When we appreciate further, as Mr. Lindgren has shown for the gold deposits of North America, that their formation was intense, relatively brief and local, and that it followed the outbreak of eruptions in each case, and that geological periods and even eras passed without vein formation, we must attribute great efficiency to the eruptive rock. The dryness of deep mines, now that it is realized, has greatly restricted our old ideas of the amount of meteoric ground-water. The tendency, therefore, to emphasize igneous agents is well justified, and is a distinct advance."

Mr. T. A. Rickard referred to the want of unanimity concerning the origin of ores, and stated it as his belief that no scheme of classification would be generally adopted while authoritative geologists remained so wide apart in their conclusions. He pointed out that the trend of opinion had favored igneous or aqueous agencies at different periods in the history of the subject, and that a gradual compromise of views seemed to be the inevitable outcome.

In Colorado it is a remarkable fact that the profitable mines are distributed through every geological terrain, from the Archean granite to a Tertiary conglomerate, and mining is going on in rocks belonging to all the principal subdivisions of geological time and amid a variety of petrographic environment which includes nearly all of the principal sedimentary and crystalline rocks. In arriving at the age of the country enclosing these lodes it has frequently been difficult to consider the sedimentary apart from the intrusive igneous rock and it is not too much to say that there is not a mining district, among the sixty-five which he has tabulated, in which igneous rocks do not occur in close association with the ore deposits.

Mr. F. L. Ransome, while not denying that pneumatolysis might be an effective factor in ore deposition, considered that the genetic classifications recently presented to the society carried this suggestive hypothesis further than facts warrant. He illustrated some of the objections to the extreme views of the igneous school of ore-deposition by reference to the occurrence of ores in the Mother Lode district of California, the San Juan and Rico districts in Colorado, and the Globe and Bisbee districts in Arizona. It was pointed out that the important ore-bodies of these districts were formed after the neighboring eruptive rocks had solidified, and that pneumatolysis, so far as known masses of igneous rock were concerned, was not directly active in ore-genesis. His own experience led him to regard the action of heated water, probably for the most part of meteoric origin, as the most generally effective agent in the formation of the greater number of ore-bodies, as we know them.

Professor C. R. Van Hise stated that in order to get a proper perspective for the appreciation of differences of view, it would be well first to give a summary of points of agreement. Attention was called by the speaker to the fact that, in his paper published

two years ago, upon 'Some Principles Controlling the Deposition of Ores,' it was stated that the metals of some ores are derived directly from adjacent igneous rocks; that the igneous rocks are the ultimate source of all the metals of ore deposits; that igneous rocks have an influence upon ore deposits by contributing metals and solutions to them, and a very important effect in heating solutions of meteoric origin.

As a basis for discussion the following provisional genetic classification was submitted:

Metallic Ore Deposits.
- (*A*) Sedimentary.
  - (*a*) Chemical precipitates.
  - (*b*) Mechanical concentrates.
    - (1) Residuary deposits.
    - (2) Stream deposits.
    - (3) Beach deposits.
- (*B*) Igneous. {Magmatic segregations.
- (*C*) Metamorphic.
  - (*a*) Ores deposited from gaseous solution.
  - (*b*) Ores deposited from aqueous solution.
    - (1) Ascending waters.
    - (2) Descending waters.
    - (3) Ascending and descending waters.

The classing of a large proportion of ores as pneumatolytic, fumarolic, solfataric and pneumato-hydato-genetic, in various recent publications, was deprecated. It was asked 'what are the criteria by which ore deposits are known to be deposited by gaseous solutions?' If this question can not be satisfactorily answered, what can be said as to the criteria upon which ores deposited by gaseous solutions are again subdivided? The placing of various ore deposits of many well-known districts in such classes as fumarolic solfataric, pneumatolytic, etc., without giving evidence for such a distribution, seemed to the speaker to be premature.

The criteria by which ores deposited by aqueous solutions may be discriminated were briefly summarized and the conclusion reached, from the application of these criteria, that this class of ore deposits is one of greater importance to men than any other class, and probably of greater importance than all other classes.

W. C. MENDENHALL,
Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

THE 175th regular meeting was held on February 19, 1903, fourteen members present. Mr. William H. Ashmead was elected vice-president of the Washington Academy of Sciences for the Entomological Society.

Mr. Ashmead exhibited two species of wasps from Chile. The first, *Agenia xanthopus* Spinola, is remarkable because of the very short wings possessed by both sexes. This species is a synonym of *Pompilus gravesii* Haliday and will fall into the genus *Sphictostethus* of Kohl. The other species was *Cosila chilensis* Spinola, the type of Mr. Ashmead's family Cosilidæ.

Dr. Dyar presented the description of a new genus and species of Geometrid moths from Stockton, Utah, exhibiting specimens. He presented, further, a synoptic table for separating the North American white-marked species of *Eucosma,* a genus of moths belonging to the family Tortricidæ, with the description of a new species from Colorado. Dr. Dyar showed also a copy of Volume VII., Number 1, of *The Insect World,* the entomological magazine published in Japanese by Y. Nawa, which contains a colored plate of a moth and larva parasitic upon a leaf-hopper belonging to the homopterous family Fulgoridæ. He said that this was of special interest in connection with the species found by Messrs. Schwarz and Barber in New Mexico and which he had recently described before the society as a new species, *Epipyrops barberiana.* The moth figured by Mr. Nawa seems to be also an *Epipyrops.* It is not yet clearly known what is the food of these larvæ. Westwood supposed that they fed upon the white secretion of the Fulgorids, but Mr. Nawa, in his account of the Japanese species, stated that the larvæ secreted a white covering, and Dr. Dyar did not think it reasonable that the larvæ should secrete a substance sim-

ilar to their own food. As there was but little of this pruinose matter on the host, certainly not enough to support several larvæ, he inclined to the opinion that the *Epipyrops* larvæ might prove to be true parasites.

Mr. Simpson showed a micro-photograph of sections of the eversible gland of the Io moth larva (*Automeris io* Fabricius). He stated that, in exceptional specimens, this gland was missing.

A paper by Mr. August Busck, 'Notes on Brackenridge Clemens's Types of Tineina,' was presented. It consisted of detailed studies of Dr. Clemens's types of Microlepidoptera in the Academy of Natural Sciences of Philadelphia, resulting in the identification of all but eight of his 200 species. Of these eight, five have been identified with certainty from the descriptions.

Mr. Ashmead spoke on 'Some Remarkable New Genera in Cynipoidea,' exhibiting specimens of nine new genera of gall-wasps from Brazil and California, and commenting upon their peculiarities.

Dr. Dyar presented the first part of a 'List of Lepidoptera taken at Williams, Arizona, by Messrs. Schwarz and Barber.' The list included 139 species, fifteen of which were described as new.

A paper by Mr. A. N. Caudell, 'Notes on the Nomenclature of Blattidæ' (cockroaches), dealt with the question of determining the type species of the Linnæan genus *Blatta*. The author showed that Latreille, before any of the old species had been removed from the genus, designated *Blatta orientalis* as the type. He proposed a new generic name for the 'croton bug,' *Phyllodromia* being preoccupied in the Diptera.

The three following papers were read by title: 'Neuropteroid Insects from Arizona,' by Nathan Banks; 'The Genera of the Dipterous Family Empididæ, with Notes and New Species,' by D. W. Coquillett; 'Myrmeleonidæ from Arizona,' by Rolla P. Currie.

Rolla P. Currie,
Recording Secretary.

NEW YORK ACADEMY OF SCIENCES.
SECTION OF BIOLOGY.

At the February meeting papers by Dr. W. A. Cannon, Professor Bashford Dean and Professor H. F. Osborn were presented.

Dr. Cannon's paper, 'Cytological Studies of Variation in Hybrids,' was based upon his studies of hybrids of cotton plants, and discussed the relation between the maturation mitoses in hybrids and the variation of the hybrid race. Two forms of mitosis occur in fertile hybrids. One of these is the normal type, which occurs in pure races and may be supposed to give rise to reproductive cells of pure descent. This is the form in hybrids between closely related parents (monohybrids), and probably forms the basis for the regular reversion in them. The other type of mitosis is irregular. It is suggested that this kind of maturation mitosis may organize cells of mixed descent, and if found in hybrids from parents rather distantly related, would constitute the basis for such mixture of the characters of the pure parents as occurs in these hybrids. However, after the characters have become mixed in all possible proportions, and the limit of variation thus reached, normal mitoses probably occur. Thus it appears that the mingling of the characters, as well as the regular reversion in hybrids, may have a morphological basis.

Professor Dean, in a paper entitled 'Past and Present Study of Zoology in Japan,' first reviewed the history of the study of zoology, and then considered the present status of zoological investigation and teaching in that country. With the aid of lantern illustration, descriptions were given of the laboratories, the fauna available for study, and the prominent Japanese workers.

Professor Osborn's paper, 'On the Primary Divisions of the Reptilia into Two Subclasses,' was presented by Dr. Hay. This has been published in full in Science for February 13, 1903.

The third meeting of the year was held at the American Museum of Natural History on March 9, Professor Bashford Dean presiding. The following papers were presented:

Mr. W. S. Sutton, in a paper on 'Chromosomic Reduction in its Relation to Mendel's Law,' pointed out that the processes of synapsis and reduction in the germ-cells of the grasshopper, *Brachystola,* are such as to indicate strongly that they are the causes of the character-reduction which forms the basis of the Mendelian principle of heredity. Probably the reducing division in *Brachystola* does not effect a separation of chromosomes into maternal and paternal groups, but the chromosome-series of the mature germ-cells is made up of a chance combination of chromosomes from the two parents. This is in accord with the results of Mendel and others who have shown that hybrid offspring exhibit a chance combination of characters from the two parental lines.

Professor Graham Lusk discussed the 'Influence of Nutrition on the Growth of Young Mammals,' basing this paper upon experiments conducted in his laboratory by Dr. Margaret B. Wilson (*Amer. Jour. Phy.,* VIII., 197, 1902), whose results support his own earlier work. It was shown that new-born pigs develop normally when fed with skimmed cow's milk, or with the same milk to which three per cent. of dextrose or lactose has been added. The growth is proportional to the calorific value of the food—always supposing sufficient proteid to be present. This agrees with the results of other workers who have studied the growth of children and other young mammals. The growth of the pigs was on the average about 215 grams growth for 1,000 calories in the food. Eighteen to nineteen per cent. of the energy of the food was retained in the body as new tissue.

The third paper, 'On the Colors and Color-Patterns of Certain Bermuda Fishes,' by Professor C. L. Bristol, dealt with correlations between habits and appearance with reference to warning and protective coloration of these fishes. An abstract will soon appear in SCIENCE in the proceedings of the American Morphological Society. M. A. BIGELOW,
Secretary.

KANSAS ACADEMY OF SCIENCE.

THE 35th annual meeting of the Kansas Academy of Science was held in the Museum room of the academy at Topeka, December 31, 1902, and January 1 and 2, 1903. There was a large attendance of members and twenty-five new members were elected. The reports of the officers for the past year showed that the academy was in a prosperous condition. New and comfortable quarters have been recently given to the academy by the state.

These rooms are in the Capitol building at Topeka and include office and museum rooms, well furnished. At the sessions of the academy forty-three papers were presented on biological, chemical, geological and physical subjects. Most of these papers will appear in the eighteenth volume of the academy *Transactions,* now in press.

Among the papers presented, the following might perhaps be noted as of general interest: 'The Flora of Kansas,' by B. B. Smyth and J. H. Schaffner; 'Further Notes on Loco Weed,' by L. E. Sayre; 'Food Habits of California Sea Lions,' by L. L. Dyche; 'Ionic Velocities in Liquid Ammonia Solutions,' by E. C. Franklin; 'Crystalline Liquids,' by Fred S. Porter; 'Examination of Some Kansas Petroleum,' by Edw. Bartow and E. V. McCollum; 'The Extent and Thickness of the Oklahoma Gypsum,' by C. N. Gould; 'On the Alkyl Sulphates,' by F. W. Bushong; 'The New Washburn College Telescope,' by H. I. Woods; 'Experiences with Early Man,' by Chas. H. Sternberg.

A number of valuable papers on Kansas entomology were presented by two Kansas authorities, Warren Knaus and Dr. F. H. Snow. The disputed subject of gold in Kansas was discussed in a paper by Professor J. T. Lovewell. The public address was given by the retiring president, J. T. Willard, on the subject, 'The Mission and Limitations of Science.'

The following were elected officers for 1903:

President—J. C. Cooper, Topeka.

Vice-Presidents—Edward Bartow, Lawrence, and J. A. Yates. Ottawa.

Treasurer—Alva J. Smith, Emporia.

Secretary—G. P. Grimsley, Topeka.

The next meeting of the academy will be held near the close of 1903 at Manhattan.

It was decided to revise and enlarge the exchange list of the academy *Transactions*.

G. P. Grimsley,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE ACTIVITY OF MONT PELÉE.

The generally friendly tone of your reviewer's (T. A. J., Jr.) notice of my 'Mont Pelée and the Tragedy of Martinique' makes it almost ungenerous on my part to take exception to any of the statements that this notice contains. There is one point, however, dealing directly with the physics of Mont Pelée, that seems to me to deserve attention from its bearing upon volcanic phenomena generally. Your reviewer takes strong exception to the use that I have made of Russell's formula in computing the cubical content of the ash-cloud, and remarks that the defect in my reasoning 'lies in the assumption that a primary eruption is continuous for days or even hours.' The somewhat surprising statement follows that: "Professor Heilprin has failed to discriminate primary and secondary eruptions when he talks of Mt. Pelée 'being in a condition of forceful activity for upwards of 200 days.'" This does scant justice to my powers of observation, for it takes no scientist to separate or discriminate between the two classes of phenomena, any more than it requires a scientific eye to note the difference between the explosion of a dripping drop from a 'boiling kettle' and the 'blow' that issues from the snout. I fear that Dr. Jaggar has not seen Pelée in 'Pelée's glory,' otherwise he could hardly have hazarded the statement to which attention is called, and still less the subsequent one that 'the reviewer questions whether the volcano has been forcefully active from great depths for that many [200] minutes.' Had Mr. Jaggar been on the island of Martinique at any time during the days August 25 to September 3, inclusive, his conception of a 'primary eruption' would be very different from what it manifestly now is—he would have seen a raging central eruption continuous for that time, and not a landscape of 'tremendous puffs that rise many thousand feet.'

When I prepared the chapter of my book which contains the calculations to which my reviewer takes exception, I was unaware of the conditions of the volcano which followed after my leaving the island. These are in many ways most interesting, and tend to confirm my conclusions as to the extraordinary quantity of the sedimental discharge from Pelée. The continuous activity of the volcano has been such that in the interval between the first week in September and the middle of December the mountain had increased its height by nearly or quite 900 feet (!), the needled summit of the cone (which had united with the old crateral wall) being on December 16, as measured by Lacroix, 4,995 feet above sea-level. Much of this has since been destroyed, but Pelée is still at its work, adding to the 300 feet of ash that it has already laid down in parts of the valley of the Rivière Blanche. I do not think that the volcano can be seriously accused of working in working times of 'five or ten minutes.' In the days of the August-September activity, I feel satisfied—although necessarily lacking the means of *proving* the accuracy of my belief—that the continuous ash-discharge could not have been less than twenty per cent. of the measure of the steam-cloud; it may have been very much more.

Angelo Heilprin.

Philadelphia, Pa.,
March 17, 1903.

THE PUBLICATION OF REJECTED NAMES.

I am glad to see Mr. Bather's letter, although I can not altogether agree with what he says. My view is that if a description appears, accompanied by two or more names in the same publication, all being simultaneous in point of time, nothing but 'priority of place' can furnish a certain and invariable rule for selecting the one to be retained. I do not want to disturb existing rules, but I do want to see the same rules in use for all groups of animals and plants. My objection to the action of Messrs. Banks and Knowlton was based on the fact that they seemed to me

to err against the most generally accepted rule covering the particular matter discussed; and even if I grant, for the sake of argument, that this opinion was wrong, it still remains true that they unnecessarily created difficulties and left opportunities for an annoying divergence of opinion.*

Systematists might 'be much happier' for the time being if left to go their own ways, but the trouble would merely be thrown with increased force on the shoulders of those coming after. Dr. D. S. Jordan, when recently replying in SCIENCE to a criticism of mine, indicated the desirability of letting each case stand on the basis of the original publication, and not leaving the types of genera or species to be determined by the process of subsequent elimination. Now as a matter of plain common sense this is surely much to be commended, but if I adopt Dr. Jordan's view (as I should much prefer to do), what am I to do about the innumerable names of genera (especially among the Lepidoptera) which have been determined by the 'elimination process'? It is surely excusable to wish to be consistent.

Zoologists seem to be agreeing to the eminently sensible view that homonyms must be exactly alike, not merely similar. Botanists, however, have made and are making many changes on account of mere similarity in names. For example, *Batschia carolinensis* Gmelin, 1791, is a *Lithospermum*, and the name of the species is suppressed (being changed to *gmelini*) because of *Lithospermum carolinianum* Lamarck, which is an *Onosmodium*. According to my view the first mentioned plant should be *Lithospermum carolinensis* (Gmel.). Many names of genera, even in zoology, are changed for such reasons, and as the matter can not be yet said to be settled, I think it is worth while to make as strong a stand as possible for the rule 'no homonymy without absolute identity of names.'

* According to the plan indicated by Mr. Bather for saving the name *Cucumites lesquereuxii*, most published species would be nameless, as the name rarely occurs *after* the description! I should like to know what Mr. Bather thinks about the substitution of *Washingtonia* Raf., for *Osmorrhiza* Raf. as now adopted by American botanists.

Zoologists generally agree that when subgenera or sections are raised to the rank of genera, the subgeneric or section names must be retained for the genera. Botanists, however, have frequently denied this altogether.

All these divergent practices are productive of future difficulties, and I can not see that anything is gained by going ahead with our eyes shut. Uniformity has to come, sooner or later.

T. D. A. COCKERELL.

A RARE SCIENTIFIC BOOK.

TO THE EDITOR OF SCIENCE: I would like information concerning the following very rare scientific book:

Purkenje: 'Commentatio de examine physiologico organi visus et systematis cutanei. Vratislav' (Breslau), 1823. Francis Galton states in 'Finger Prints' ('92), that there is *one copy in America*. As I am desirous of locating this or any other American copy, I shall be grateful to any one who can give me information on the subject.

HARRIS HAWTHORNE WILDER.

SMITH COLLEGE,
March 6, 1903.

SHORTER ARTICLES.

ORIGIN OF THE WORD 'BAROMETER.'

THE instrument familiar to us all as the barometer was first universally known by the name of its inventor as 'Torricelli's tube'; de Guericke, the inventor of the air-pump, called his huge water-barometer 'Semper Vivum,' also 'Weather Mannikin,' with the Latin form 'Anemoscopium.'

Soon after the year 1665 the words 'baroscope' and 'barometer' came into general use in England, but the individual to whom the credit belongs for originating these terms has not been certainly known; the assertion made by a contributor to the *Edinburgh Review* for 1812 that 'baroscope' was first used by Professor George Sinclair, of Scotland, in 1668, is an error, for both words occur in the *Philosophical Transactions* four years earlier. The passage is unsigned and reads thus:

"Modern Philosophers, to avoid Circumlocutions call that Instrument, wherein a Cylinder of Quicksilver, of between 28 and 31 inches in Altitude, is kept suspended after the manner of the Torricellian Experiment, a Barometer or Baroscope, first made publick by that Noble Searcher of Nature, Mr. Boyle, and imployed by him and others to detect all the minut variations in the Pressure and Weight of the Air."

The mention of the words in connection with the name of Robert Boyle has led me to make a close examination of his voluminous and prolix writings. In Boyle's first publication, 'New Experiments Physico-Mechanical touching the Spring and Weight of the Air,' dated 1660, the words baroscope and barometer do not occur; he uses the common term 'tube,' and often writes of the 'mercurial cylinder.' Nor are these words used by him in his 'Defense of the Doctrine touching the Spring and the Weight of the Air * * * against the objections of Franciscus Linus,' a paper published in 1662.

Their use by the anonymous writer to the *Philosophical Transactions* in 1665 has been shown, and the question arises, who was this person who modestly concealed his name? I believe it was Boyle himself. This eminent man, who was so devoid of personal ambition that he declined a peerage, had a habit of writing about himself and his scientific labors in the third person, and often spoke of himself by fanciful, fictitious names, such as 'Philaretus' (in his fragmentary autobiography) and 'Carneades' (in the 'Sceptical Chymist'). That he should send an unsigned communication to a journal was not surprising, particularly as he had occasion to mention himself.

Be this as it may, my claim that Boyle originated the word barometer does not rest on such slender conjectures as these. One year later than the communication in the *Philosophical Transactions,* Boyle wrote to this journal (dated April 2, 1666) and said, 'barometrical observations (as for brevity's sake I call them),' using the personal pronoun this time. Elsewhere in the same paper are found the terms barometer, baroscope and baroscopical observations.

In his 'Continuation of New Experiments Physico-Mechanical * * * ' of which the preface is dated 1667, occurs the following phrase: 'But though about the barometer (as others have by their imitation allowed me to call the instrument mentioned).' (Boyle's Works, Birch's edition, Vol. III., p. 219, London, 1744.)

This sentence is virtually an admission by Boyle that he had coined the word, since others imitating him had allowed and encouraged him to use the term to designate the tube of Torricelli.

I conclude, therefore, that the word 'barometer' was introduced into our language by the English philosopher, the Hon. Robert Boyle, about the year 1665. Boyle, by the way, was a scholar, and able to use Greek in forming an English word. Finally, I may add that examination of Murray's Skeats' and other standard English dictionaries throws no light on the origin of the word; they merely refer to the *Philosophical Transactions* and give its obvious etymology.

HENRY CARRINGTON BOLTON.

THE RESPONSE OF THE HEARTS OF CERTAIN MOLLUSCS, DECAPODS AND TUNICATES TO ELECTRICAL STIMULATION. (PRELIMINARY COMMUNICATION.)*

THE physiology of cardiac muscle of the vertebrates is commonly regarded as differing from that of the skeletal muscle, besides the difference in rhythm, chiefly in these three points, namely, that cardiac muscle can not be tetanized, that a minimal stimulus is at the same time maximal (the 'all or nothing law'), and that, beginning with the systole, the muscle is in a condition of inexcitability, the excitability returning gradually during diastole. While making some observations on the comparative physiology of muscle in certain genera of marine molluscs at the Hopkins Seaside Laboratory in the summer of 1902, the ventricle of the systemic heart of

* From the Hopkins Seaside Laboratory and the Physiological Laboratory of Leland Stanford Jr. University.

Loligo pealii attracted my special attention, because its reactions to electrical stimulation did not seem to fall in line with the peculiarities of cardiac muscle just referred to. The *Loligo* ventricle responded to the interrupted current of sufficient intensity with a continuous, to all appearance, tetanic contraction, minimal stimuli were by no means at the same time maximal; and a refractory period or a state of inexcitability seemed not to be present.

This led to the examination of the hearts of the following invertebrates on these three points:

Tunicata:
- *Clavelina* sp.

Mollusca:
- *Octopus punctatus.*
- *Loligo pealii.*
- *Ariolimax columbianus.*
- *Limax maximus.*
- *Pleurobranchœa* sp.
- *Doris* sp.
- *Janus* sp.
- *Æolus* sp.
- *Haliotis craceropodii.*
- *Haliotis rufescens.*
- *Lucapina crenulata.*
- *Cryptochiton stelleri.*
- *Mytilus californianus.*
- *Mya arenaria.*

Arthropoda:
- *Cancer antennarius.*
- *Brachynotus nudis.*
- *Pachygrapsus crassipes.*
- *Epialtus productus.*

Owing to the delicate structure of the ventricles of *Clavelina* and the nudibranchs (with the exception of a species of *Doris*) their contractions could not be recorded by the ordinary graphic method, but direct observation had to suffice. The ventricles of all the other species worked on were suspended and their reactions recorded by a light lever. But experiments were also performed on the ventricles *in situ,* as check on the graphic record.

1. In all the forms experimented on an intensity of the interrupted current was found to which the ventricles responded with a continuous maximal or supermaximal (as compared to the normal) contraction during its application. By varying the intensity and the rapidity of succession of the shocks superposition and partial fusion of the individual contractions were obtained (except in *Cryptochiton* and in some of the nudibranchs) similar to those of the skeletal muscle of vertebrates. The continuous contraction appeared to be truly 'tetanic' in character, except in case of *Cryptochiton* and some of the gastropods. The intensity of the interrupted current required to call forth the continuous contraction was considerably greater than sufficed to tetanize the body muscles in the same animal.

2. If by the refractory period is meant a state of inexcitability, I have so far been unable to demonstrate its presence in the ventricles of this series, for an intensity of the stimulus can in every case be found sufficient to affect the hearts in any phase of rhythmic contraction; but a period of reduced excitability, maximal during the systole, seems to be present in the case of the decapods, the cephalopods and in several of the gastropods.

3. Nor does the 'all or nothing law' apply to the hearts of this series of invertebrates. But as regards this relation of the magnitude of contraction to the intensity of the stimulus, there is a great difference between the ventricle of *Cryptochiton* on the one hand and that of *Octopus* or *Cancer* on the other. The *Octopus* ventricles seem to come nearest to the vertebrate heart on this point, while the ventricle of *Cryptochiton* in no wise appears to partake of this property of vertebrate cardiac muscle. With the exception of *Cryptochiton* and *Doris* the hearts give uniform beats to stimuli of considerable range in intensity, but increase in the intensity above this range is followed by increase in the height of contraction. In *Octopus* increase in the intensity of the stimulus above a certain strength seems to decrease the magnitude of contraction.

4. If the interrupted current is too weak to produce acceleration of the beats or the continuous contraction, it produces *inhibition in diastole* during its application to the ven-

tricles of *Mytilus, Mya, Haliotis, Lucapina, Limax, Ariolimax, Octopus,* and the decapods examined, very much like the vagus inhibition in vertebrates. In *Ariolimax* and *Mya* the inhibitory effect of single induced make or break shocks is readily demonstrated. If the application of a weak, interrupted current is long continued the ventricle will generally 'escape' from the inhibition during the stimulation. Cessation of the stimulation is generally followed by acceleration in the rate and increase in the magnitude of the beats.

5. The direct current produces make beats, make and break beats, total diastolic inhibition, partial inhibition of beats, acceleration of beats, and increase in 'tone' or a continuous 'tetanic' contraction, according to its intensity and direction, *i. e.,* whether the anode or the cathode is on the auricular end of the ventricles. In *Ariolimax* this difference in the ventricular response, according as the anode or the cathode is on the auricular end, is very manifest even with single induced shocks.

An account of previous investigations touching this subject is deferred to the more complete statement which will accompany the publication of the tracings.

A. J. Carlson.

Stanford University,
January 25, 1903.

CURRENT NOTES ON PHYSIOGRAPHY.

SOUTHERN APPALACHIAN FOREST RESERVE.

'Senate Document 84' is a volume of 210 pages, 75 plates and 3 maps with the following title: 'Message from the President of the United States, transmitting a report of the Secretary of Agriculture in relation to the forests, rivers and mountains of the Southern Appalachian region' (Washington, 1902). 'Southern Appalachian Region' is the page heading throughout. The volume, whatever its name may be, is worth owning, as it presents an unusually well-illustrated account of 'the greatest physiographic feature in the eastern half of the continent,' with special reference to the creation by Congress of a national forest reserve, for conservation of the forest by use, rather than a national park, for conservation without use, as the Secretary of Agriculture puts it (p. 167). Chapters on topography and geology by Keith, hydrography by Pressey and Myers, and climate by Henry give concise accounts of these topics. Many of the plates are excellent. The text and the explanatory titles of some of the plates give, to our reading, too much importance to forest clearing as a cause of destructive floods. There seems exaggeration also in the statement under a fine view of Stone mountain, near Atlanta, Ga. (Pl. XIX.), that 'the ax and fire have removed the forest, and the heavy rains have removed the soil which once covered the larger part of this rocky knob.' It is estimated that not less than 10 per cent. of the region has a slope of less than ten degrees, while 24 per cent. of the region has been cleared. The hill- and mountain-side fields lose their surface soil in five or ten years, and must then be abandoned for new clearings. Native grasses do not suffice to hold the hillside soils, which are therefore often deeply gullied by rain wash. It is evidently out of the question to adopt the practice of terracing the hillsides, as is done by the crowded population of eastern Asia (see a good illustration in *Geogr. Journ.,* XXI., 1903, p. 116).

The Blue ridge, an important physiographic element of the region, is variously described in different parts of the volume; on one page it is 'a fairly well-defined mountain *range*'; on another, its northern part 'consists of ancient *plateaus,*' while upon 'the southern part of the *chain* * * * are situated a few individual peaks and ridges of commanding height'; again, it is a 'steep and well-defined *escarpment,*' and it fronts the Piedmont plateau 'like a *rampart.*' The italics are here introduced to emphasize the versatility of this remarkable *ridge.*

SOUTHERN PATAGONIA.

Reference has already been made in these notes to Hatcher's exploration in Patagonia. Fuller description of his geographical results has now been published ('Reports of the Princeton University Expeditions to Pata-

gonia, 1896–1899,' Vol. I., 'Narrative of the Expeditions, Geography of Southern Patagonia,' by J. B. Hatcher, Princeton, 1903, 4to, xvi + 314 pp., map and numerous plates). The narrative abounds with interesting details of three journeys. The general account of the geography, in chapters headed plains, mountains, rivers, lakes, coast, climate, and Indian tribes, is most readable and instructive, although rather brief on certain topics where additional details would be welcome. The curious relation of the large piedmont lakes, east of the mountains, to the gorges by which they are drained through the main chain of the Andes, is properly characterized as unique; too little consideration seems to be given to glacial erosion in connection with these lakes. The great transverse valleys by which the plains are broken are, for the most part, followed by small or intermittent rivers; the valleys are shown to have been eroded before the submergence of the region, during the recovery from which the great shingle formation was spread over the plains as a littoral marine deposit. The terraces in the plains are ancient sea cliffs, cut during pauses in emergence, the cliff along the present coast being the last member of the series. Morainic deposits are abundant over the western plains, and extensive lava flows are spread over the central part of the plains; some of the flows are older than the great valleys, some are younger. In one case a river that once followed a valley to the Bay of San Julian was turned southward from its course by a lava flow, so that it now reaches the sea by Rio Chico de Santa Cruz, leaving its former valley dry. The southernmost of the transverse valleys, not yet entirely emerged, forms the Straits of Magellan. The chapter on the Tehuelche tribe gives many examples of the immediate dependence of these savages on their surroundings; they have curiously enough abandoned the use of bows and arrows, remains of which are found in their old camping grounds; since the introduction of horses by the Spaniards, the bolas are the chief weapon of the Indians.

CAPTURED VALLEYS IN THE HIMALAYAS.

Freshfield, Garwood and Sella made a tour around the highest mountain in the world during the autumn of 1899, and some account of their results have lately appeared. The leader of the party gives a narrative of the trip, with a superb panorama by Sella, in an article on 'The Glaciers of Kangchenjunga' (*Geogr. Journ.*, XIX., 1902, 453–472); and Garwood follows with some "Notes on a Map of 'the Glaciers of Kangchenjunga' with remarks on some of the physiographic features of the district" (*ibid.*, XX., 1902, 13–24). From the latter article we learn that the mountain slopes in the forested belt, up to about 10,000 feet, have 'a marked convex curve produced by the thick growth of vegetation,' instead of the typical concave basal curve; that the glaciers of the district formerly extended at least several miles beyond their present ends; that lakes are rare and small; that the 'entire absence of rock basins from valleys formerly filled by ice is not without bearing on the supposed origin of lakes by glacial erosion in other alpine districts'; and that hanging valleys were observed on several occasions in greater or less distinctness.

Two conspicuous examples of the last-named features are illustrated. They are explained as the high-level valley-heads of a former east-flowing consequent river system, now captured by a deep-lying, south-flowing subsequent stream. The excessive deepening of the subsequent valley beneath its hanging laterals is referred to two causes: (1) A hypothetical elevation of the central mountain mass due to the melting off of former supposedly heavy glaciers during an assumed interglacial period or periods, as a result of which the centrifugal south-flowing subsequent stream would deepen its valley, while the streams flowing 'east and west would be merely tilted sideways, and would tend to widen rather than deepen their valleys'; (2) a postulated protection of the hanging valleys by local glaciers, which 'would linger longer in the high-level hanging valleys than in the deeper valleys below.'

Whether the deep subsequent valley was

once occupied by a glacier is not stated; but the hanging valleys join it only three or four miles from the end of a large existing glacier that is fed from the great snow reservoirs of Kabru peak (24,015 feet). Hence Garwood's explanation of these hanging valleys, involving so many hypothetical conditions—even the capture of the headwaters of the assumed east-flowing consequent being hypothetical in a region of so complicated structure and of so much dissection since the capture is supposed to have taken place—can not at present be advisedly accepted in place of the much more probable explanation by glacial erosion. The suggested explanation becomes all the less satisfactory when it is perceived to depend on two very doubtful postulates: (1) the discordant relation of trunk and branch valleys is assumed to result in part from a supposed tilting of the drainage basin, yet no proof of the principle underlying this assumption is adduced from demonstrably tilted basins in non-glaciated regions; (2) the hanging valleys are supposed to have been occupied by glaciers that maintained a highly specialized and persistent relation to the valley mouths; yet no examples are adduced to show that this relation prevails in any region of existing glaciers.

One more point; Garwood argues for the 'superior erosive power of water over ice,' and this implies a misapprehension. It is not essential to the glacial origin of hanging valleys that the *erosive power of ice should be superior to that of water,* but only that the *erosive work of ice should be unlike that of water.* How long a time the main glaciers of a mountain range may have taken to scour out their over-deepened main channels and to leave the channels of smaller side glaciers in the form of hanging valleys, and what amount of work might have been accomplished by rivers in the same time and place, no one yet knows.

W. M. Davis.

BOTANICAL NOTES.

TWO MORE BOTANICAL TEXT-BOOKS.

Within a couple of months two books for beginners in botany have been offered to the high schools of the country. The first is the 'Introduction to Botany' prepared by Professor Stevens, of the University of Kansas, and brought out by Heath & Company. It is an attempt to introduce the beginner to all departments of the science. Accordingly, he is directed in his studies of seeds, seedlings, roots, buds, stems, leaves, growth, movement, modified parts, flowers, seed dispersal, selected spermatophytes (twenty-five kinds), slime moulds, bacteria, yeasts, algæ, fungi, lichens, mosses, ferns, horsetails, adaptation to environment, plants of different regions, plants of past ages and classification. In all of these topics the subject is treated comprehensively. There is something of structure, morphology, physiology, ecology, as well as of the philosophy of botany. Throughout the chapters are scattered nearly two hundred observations and experiments to which the pupil's attention is directed. Part II. of the book describes the school herbarium, laboratory equipment, reagents and processes, and Part III. is devoted to a pretty complete but not very satisfactory glossary. A short 'flora' is appended to the volume, in which selected spermatophytes are briefly described. The treatment here is quite conservative, the old nomenclature being strictly followed, although the sequences of families are those of Engler.

The book contains a great deal of valuable matter, but it is open to the pedagogical criticism of not separating the elementary and fundamental from the advanced and more technical aspects of the science. In the hands of a wise and well-trained teacher it will be a helpful book, but in too many cases its use will leave the pupil in a more or less dazed and confused state of mind, on account of the fact that too many things have been brought to his notice in the short time allotted to the study. The author should prepare another book in which only the elementary and fundamental parts of the subject are presented to the beginner, and then the present work might be enlarged and elaborated for the use of advanced students.

The second book, with the suggestive title 'Botany all the Year Round,' is from the hand of E. F. Andrews, of the High School

of Washington, Georgia, and bears the imprint of the American Book Company. As stated by the author, the book 'aims to lead the pupil to Nature for the objects of each lesson, and to provide that the proper material shall always be available by so arranging the lessons that each subject will be taken up at just the time of the year when the material for it is most abundant.' The book thus assumes that the work is to begin in September, and continue the whole year, which is quite right. The pupil first takes up the leaf and its uses, in which such subjects as transpiration, respiration, the parts of the leaf, leaf arrangement, leaf adjustment and transformation of leaves are studied. He next studies fruits, under the topics, fleshy, dry, dehiscent and aggregate fruits, and this is followed by studies of seeds and seedlings, where he learns about monocotyledons and dicotyledons, the forms, growth and germination of seeds, etc. In like manner he studies roots, and underground stems, the proper stem, buds, branches and flowers. All of this takes 236 of the 300 pages of the book. Then we have a short chapter (14 pages) on ecology, followed by 36 pages devoted to the lower plants. The appendix contains a most useful list of books for reference, and the index appears to be satisfactory. While it emphasizes too much the higher forms of plants at the expense of the lower, reminding us at once of the old Gray's 'Lessons in Botany,' which it is evidently intended to replace in the southern states, it is perhaps as advanced a book as can be used successfully in the region for which it was written. The compound microscope is evidently a thing almost undreamed of in the schools for which it is intended, and so there is nothing else to be done but to send the youngsters into the fields for their laboratory work. Like the preceding book, this one attempts too much, but the fault is not quite so great here as there.

All in all, the two books are creditable additions to the already long list of American textbooks of botany. When they have been tried by some years of practical use in the schools they can be so revised as to improve them along the lines suggested above. In the meantime they will be helpful to many teachers in the secondary schools of the country.

PLANT PATHOLOGY IN THE COLLEGES.

In the 'Proceedings' of the Sixteenth Annual Convention of the Association of Agricultural Colleges and Experiment Stations, held at Atlanta, Ga., October 7–9, 1902, Professor Wilcox, of Alabama, makes some lively criticisms of botanical teaching in the colleges and universities of the country. His remarks are of course mainly directed towards the agricultural colleges, but they apply with equal force to the larger institutions. In but few of the colleges is there any attempt to teach plant physiology, and where it is entered as one of the botanical courses Professor Wilcox shows that it is often not physiology at all that is given. Pathology as a subject for the study of the college student is almost unknown even in the agricultural colleges. He says "the situation respecting the teaching of plant pathology is even more serious and non-effective than that of physiology. Substitution of an entirely different subject from real pathology seems to be the rule rather than the exception in the teaching of this subject." The difficulty which faces the Bureau of Plant Industry in the United States Department of Agriculture every time an additional plant pathologist is wanted is an indication of the truth of the charge brought against the colleges by Professor Wilcox.

A DISEASE OF THE WHITE ASH.

Dr. Hermann von Schrenk, of the United States Department of Agriculture, in charge of the Mississippi Valley Laboratory at St. Louis, has issued a bulletin describing a disease of the white ash caused by the fungus *Polyporus fraxinophilus*. The disease is prevalent in the Mississippi valley, and is particularly severe in Missouri, Kansas and Nebraska, where this tree reaches its western limit. The disease, which has been named the 'white rot,' changes the hard wood of the tree into a soft, pulpy, yellowish mass, making it unfit for lumber purposes, and bringing about the early death and overthrow of the tree. Accordingly, in regions where this

disease is common the ash never grows to be a very large or very old tree. It is said that in Forest Park, St. Louis, nearly all of the white ash trees are diseased. Susceptibility to the disease, mode of entrance of the parasite, the microscopic changes of the wood, and remedies, are discussed in this bulletin. Five excellent plates serve to make the matter plainer than is possible by text alone.

Charles E. Bessey.

The University of Nebraska.

THE BRAIN OF SILJESTRÖM.

The brain of Professor Per Adam Siljeström, of Stockholm, has recently been described by Retzius.* Siljeström was an eminent physicist and pedagogue who died in 1892 at the age of seventy-six. He was connected with the Paul Gaimard Polar Explorations, and is best known for his valuable researches on Mariotte's law, and for his efforts in behalf of the reformation of the school systems in Europe. Most of his work in this line was done subsequent to his visit to the United States in 1849–50, where he studied the various school systems and published his views. His intellectual abilities are spoken of as having been of the highest order.

Retzius adds his description of this brain to those of the astronomer Hugo Gylden and the mathematician Mme. Sonya Kovalewski. Siljeström's brain weighed 1,422 grams and is splendidly developed. Its convolutions are particularly rich in the frontal and parietal association areas, and it appears in most respects more complex than do those of Gylden and Kovalewski. The brain shows that special order of normal asymmetry so typical of the higher brains. As in Gylden's and Kovalewski's brain, the right Sylvian fissure proper is shorter (47 mm.) than the left (58 mm.), and the marginal gyre shows a similar complexity; these features are of interest in their possible relation to the mathematical abilities of these persons.

A small abscess of the size of a hazelnut involved the right subfrontal gyre.

E. A. S.

* *Biologische Untersuchungen*, Neue Folge, X., 1902 (Stockholm).

THE NEW ALGOL VARIABLE.

The Algol variable, 4.1903, recently discovered by Mme. Ceraski, proves to be an object of unusual interest. The Carnegie grant has enabled an examination of the photographs, taken with the Draper telescopes, to be made. This has shown that the star has a period of 1.3574 days $= 1^{d}\,8^{h}\,34^{m}.7$, and a range of 2.4 magnitudes. About half an hour before minimum, the rate of diminution in light amounts to between two and three magnitudes an hour, and is probably greater than that of any other star yet discovered. A minimum was predicted here, and was observed photographically and photometrically, 1903, March $19^{d}\,16^{h}\,24^{m}$, G. M. T.

Edward C. Pickering.

Harvard College Observatory,
March 24, 1903.

SCIENTIFIC POSITIONS UNDER THE GOVERNMENT.

The Civil Service Commission announces that on May 5, 1903, an examination will be held for the position of assistant physicist. The subjects and weights are:

1. Education and experience.................... 50
2. Thesis (each competitor will be required to present a thesis of not less than 2,000 nor more than 2,500 words on some subject appropriate to the line of work indicated by the special subject of the examination below which he proposes to take; thesis to be prepared prior to date of examination and to be given to examiner on that date. In preparation of thesis, competitor may consult such books or publications as he desires, but the thesis must be entirely his own composition and must be accompanied by an affidavit to this effect) 20
3. Any one, *and only one*, of the following four subjects:
   (*a*) Magnetic testing and research and the absolute measurement of electrical quantities, such as currents, resistances, capacities, inductances, etc.
   (*b*) Electrical testing and photometry. This includes the testing of instruments used for the measurement of both direct and alternating currents, of the various switchboard, portable,

and laboratory types. Also the photometric testing of incandescent and arc lamps, and such experimental and research work as may be involved in developing methods of testing.

(*c*) Radiation, pyrometry and phytometry. The study of thermal radiation and the determination of high temperatures and luminous intensities by radiation measurements; also the investigation of various standards of light.

(*d*) Mechanics, hydraulics and engineering, especially as applied to the study and testing of gas and water meters, pressure gauges and the various instruments for measuring high and low pressures, anemometers, engine indicators, speed counters and other engineering instruments 30

Total 100

Applicants must show that they have been graduated from colleges or technical schools or that they have attained an equivalent education. A preliminary rating will be made of the first subject as shown by the application and accompanying vouchers, and those competitors who fail to attain at least 70 per cent. on this portion of the examination will not be given a rating on the thesis under the second subject nor the examination test under the third subject. From the eligibles resulting from this examination it is expected that certification will be made to fill four vacancies in the position of assistant physicist in the National Bureau of Standards, two at a salary of $2,200, one at $1,800, and one at $1,600 per annum, and to other similar vacancies as they may occur.

On April 21, 1903, there will be an examination for the position of scientific assistant, the subjects and weights being:

1. College course with bachelor's degree (including a certified statement in detail of courses of study pursued and standing in each) 40
2. Post-graduate course or special qualifications (including a certified statement in detail of courses of study pursued and standing in each) 30
3. Thesis, or other literature (on a scientific subject bearing upon the work the applicant desires to pursue) 30

Total 100

Applicants who comply with the preliminary requirements may be examined in one or more of the following subjects. Each of these subjects, however, is rated independently and constitutes a distinct examination in itself: Agricultural statistics; agrostology; chemistry, agricultural; chemistry, analytical, methods for the detection of food adulteration; chemistry, analytical, official methods, except food adulteration; chemistry, analytical, qualitative and quantitative, including analytical chemistry used in connection with important industries; economic botany; entomology; forestry; horticulture (candidates in this subject should state their qualifications for service in Porto Rico and Hawaii); library science; physiology and nutrition of man; plant bacteriology; plant breeding; plant pathology; plant physiology; pomology; rural engineering, especially as applied to irrigation and drainage; seed testing.

From the eligibles resulting from this examination it is expected that certification will be made to the position of scientific assistant in the Department of Agriculture and to other similar vacancies as they may occur.

THE DESERT BOTANICAL LABORATORY.

THE Desert Botanical Laboratory of the Carnegie Institution will be located at Tucson. Mr. Frederick V. Coville and Dr. D. T. MacDougal, the advisory board of the laboratory, after a trip in January and February through the deserts of Texas, New Mexico, Arizona, California, Chihuahua and Sonora, reported in favor of locating the laboratory at Tucson, and the executive committee of the Carnegie Institution has approved the selection. The actual site of the building is on the shoulder of a mountain two miles west of the city of Tucson. This mountain and the adjoining mesas bear a splendid representation of such characteristic desert forms as *Cereus giganteus, Fouquiera, Opuntia, Echinocactus, Covillea* and *Parkinsonia.*

The officers of the University of Arizona and of the Arizona Agricultural Experiment Station have taken a lively interest in the project and the Tucson Chamber of Commerce expressed its appreciation of the importance of the enterprise by donating the site, installing a water supply, electric connections and rendering other valuable assistance.

Plans for building have been approved and construction will be begun as soon as the site is prepared. It is expected that the laboratory will be ready for operation about September 1, at which time Dr. W. A. Cannon, the resident investigator, will take up his duties.

THE U. S. NATIONAL MUSEUM.

The last Congress appropriated $3,500,000 for a new building with granite fronts for the U. S. National Museum. This will be placed on the mall to the north of the Smithsonian Institution and at a suitable distance from it. Tentative plans for such a building were submitted to Congress in response to a resolution passed at the previous session, but the fortunate change from brick and terracotta will necessarily lead to some alterations, particularly in the design for the exterior. The general arrangement of the halls and the amount of floor space will, however, remain practically the same as in the provisional plans. These contemplate a rectangular building, about 480 feet front and 350 feet deep, surrounding two open courts, and about 80 feet high including the basement. The building will afford about 400,000 square feet of floor space, or nearly nine and a half acres, and is designed for four floors, the first and second to be used for exhibition purposes, the basement and upper floor to be for the arrangement of the reserve, or study series, for workrooms and other necessary museum purposes. A special effort will be made to have the offices of the museum staff not only near the study series, but as near as possible to their respective exhibition halls, while the lighting of the exhibition halls will be mainly from the sides, in order to avoid dark corners and reflection.

The construction of the new museum is to be in charge of Mr. Bernard R. Green, who had the supervision of the new building for the Library of Congress. The sum of $250,000 was appropriated for the first year. The preparation of working plans will be proceeded with at once, and it is hoped that contracts for the work may be made early in July so that the building may be commenced as soon as possible.

THE APPROPRIATION FOR THE U. S. DEPARTMENT OF AGRICULTURE.

The appropriation for the current expenses of the United States Department of Agriculture provided by the recent session of Congress covers a total of practically six million dollars—$5,978,100, to be exact. This is an increase of $769,140 (including an emergency appropriation for foot-and-mouth disease) over the appropriation for the present year. During the past five years the amount of the appropriation for the department has increased over two and one quarter million dollars.

The increased funds are for the most part to enable an extension of the work of the department along its present lines rather than to take up new special features. Nearly every bureau and division receives additional funds, but the wording of the appropriation act mentions very few new undertakings. Indeed, the wording is now so comprehensive as to render this unnecessary, and makes the legitimate field of the department cover practically all science as applied to agricultural investigation and practice. One new bureau is recognized—the Bureau of Statistics, which is raised from the grade of division. The scientific staff of the Weather Bureau is increased somewhat, an assistant chief being added, among others, and the bureau is authorized to erect five observatories and to establish cable communication between Block Island and Narragansett Pier, with terminal buildings and equipment at each place. The Bureau of Animal Industry receives an increase of $100,000 for its meat and other inspection work, and an emergency appropriation of $500,000 is placed at the disposal of

the Secretary of Agriculture to stamp out the foot-and-mouth disease and other contagious diseases of animals which may appear. The appropriations for the experiment stations in Hawaii and Porto Rico are increased to $15,000, making them uniform with the appropriation for stations in other states and territories, and $5,000 is appropriated for taking up the farmers' institute work with a view to assisting the organizations in the different states and territories and making them more effective means for the dissemination of the results of the work of the department and of the agricultural experiment stations. A farmers institute specialist, who has had long experience in this line of educational work, has been appointed upon the staff of the Office of Experiment Stations, and will take up the new enterprise in April. The fund for the purchase of seeds for congressional distribution is increased by $20,000, being now $290,000, but an additional $10,000 is allowed to be expended out of this fund for the seed and plant introduction from foreign countries, making the fund for that purpose $30,000.

The items carried by the act for the various bureaus and divisions are as follows: Office of the Secretary, $74,600; Weather Bureau, $1,248,520; Bureau of Animal Industry, $1,287,380; emergency appropriation for foot-and-mouth disease, $500,000; agricultural experiment stations and Office of Experiment Stations (including irrigation investigations and nutrition investigation), $895,000; Bureau of Plant Industry, $674,930 (increase of $62,200); Bureau of Forestry, $350,000 (increase of $58,140); Bureau of Soils, $212,480 (increase of $42,800); Bureau of Chemistry, $85,300 (increase of $15,500); Bureau of Statistics, $156,660 (increase of $15,500); Division of Entomology, $77,450 (increase of $10,000); Division of Biological Survey, $51,850 (increase of $6,000); Division of Publications, $229,320 ($105,000 of which is to be used for the preparation and printing of Farmers' Bulletins); Division of Foreign Markets, $16,000; Public Road Inquiries, $35,000; Library, $20,000; Division of Accounts, $24,350; contingent expenses, $37,000; Museum, $2,260.

This statement does not include the funds available for printing the publications of the department, which are carried by another appropriation.

Congress also gave authority for the erection of suitable buildings for the department, to cost not exceeding $1,500,000, and $250,000 was appropriated for the work to be done on these buildings during the coming year.

The total appropriations made by the Fifty-seventh Congress for the department aggregate $12,005,133.80.

SCIENTIFIC NOTES AND NEWS.

The American Museum of Natural History announces the appointment of Dr. Livingston Farrand, of Columbia University, as assistant curator of ethnology, and of Professor William Morton Wheeler, now of the University of Texas, as curator of invertebrate zoology.

Professor Andrew C. McLaughlin, who has filled the chair of American history at the University of Michigan since 1891, has been selected by the trustees of the Carnegie Institution to organize a bureau of historical research and to direct its investigations. Professor McLaughlin has been given a leave of absence from the University of Michigan for the coming college year in order that he may take up this new work. The larger part of the investigations will be carried on in connection with the government archives at Washington.

The daily papers state that Professor Raphael Pumpelly, of Newport, R. I., has gone to Turkistan to make explorations under the auspices of the Carnegie Institution.

Dr. Wilhelm Bauers, of the Royal Ethnological Museum, Berlin, is at present at Mexico studying the native tribes.

Professor Volney M. Spalding, head of the botanical department of the University of Michigan, has been granted leave of absence by the board of regents for the next academic year. He will devote the time largely to studies of plant distribution, visiting various European collections and traveling elsewhere.

In harmony with the invitation received from the German government, the Secretary

of State, acting on the nomination of the Secretary of Agriculture, has issued the necessary credentials appointing Dr. H. W. Wiley, chief of the Bureau of Chemistry, U. S. Department of Agriculture, the official representative of the United States at the Fifth International Congress of Applied Chemistry, to be held at Berlin on June 8, 1903. Dr. Wiley has acted in this capacity at each of the four preceding congresses and his wide acquaintance with European men of science, as well as his international reputation as a chemist, fit him preeminently to discharge the obligations of this post with honor to the United States. The details of organization of this congress are to be found in Science for February 20, on page 315.

It is expected that Dr. Walter Nernst, professor of electrochemistry at the University at Göttingen, will visit the United States this month.

The Bessemer gold medal of the Iron and Steel Institute of Great Britain has been awarded to Sir James Kitson, M.P., past-president, in recognition of his great services to the iron and steel industry of Great Britain. The presentation of the medal will be made by Mr. Andrew Carnegie at the annual meeting on May 7.

Professor Woodhead and Dr. Anningson have been appointed representatives of Cambridge University at the congress of the Royal Institute of Public Health to be held at Liverpool in July next.

Mr. William Weber Coblentz, graduate scholar in physics, at Cornell University, has been appointed to a research assistantship by the Carnegie Institution. Mr. Coblentz will continue his investigations, already well advanced, of absorption spectra in the infra-red. The work will be done in the Physical Laboratory of Cornell University.

Dr. F. S. Wrinch, at present demonstrator in experimental psychology at Princeton University, has been appointed to a research assistantship in psychology by the Carnegie Institution.

Sebastian Albrecht, graduate student in the University of Wisconsin, has been appointed to a fellowship in astronomy at the Lick Observatory.

The coming commencement season will complete the twenty-fifth year of President G. Stanley Hall's philosophical doctorate, taken at Harvard in 1878. It has seemed to a number of his colleagues and former students that this occasion should not be allowed to pass unnoticed, but on the contrary, should be marked in a manner commensurate, in some degree, with President Hall's service to psychology and its teaching in this country. The form which will accomplish this end in a way most agreeable to President Hall himself is the publication of a worthy *Festschrift* in his honor. Professor E. C. Sanford, of Clark University, and Professor E. B. Titchener, of Cornell University, as co-editors with President Hall of the *American Journal of Psychology,* which he founded in 1887, have, therefore, decided to invite contributions from a number of his colleagues and the more actively productive of his past students, and will see the collection of papers through the press.

Mr. G. T. Walker, a recent senior wrangler at Cambridge, has been appointed head of the Indian Meteorological Department.

Dr. James J. Dobbie, professor of chemistry and geology in the University College of North Wales, has been appointed director of the Museum of Science and Art, Edinburgh, in succession to F. Grant Ogilvie, Esq., who has been appointed a principal assistant secretary under the Board of Education at South Kensington.

At the monthly general meeting of the London Zoological Society on March 20, Mr. W. L. Sclater was officially proposed as secretary in succession to his father, Dr. Sclater, who retired in January. At the instance of those opposed to Mr. Sclater's election a meeting of the fellows was held on March 20, at which Mr. Chalmers Mitchell was nominated for secretary. The election will take place on April 29.

Dr. David Starr Jordan, of Stanford University, gave the principal address at the exercises commemorating the thirty-fourth anniversary of the University of California, his

subject being 'American University Tendencies.'

DR. F. A. WOLFF, of the National Bureau of Standards, Washington, will discuss 'Modern Methods of Electrical Standardizing' before the Franklin Institute of Philadelphia on March 26.

THE winter term public meeting of the Ohio State University Chapter of the Society of the Sigma Xi was addressed this year by Professor C. B. Morrey, his subject being the 'Uses of Bacteria.' Of especial interest was the elaboration of the author's theory of the bacterial formation of coal and natural gas.

MR. CHARLES A. DAVIS, instructor in forestry, in the University of Michigan, has been engaged to prepare a map showing the distribution of forest trees and soil relations for the Ann Arbor sheet of the topographic atlas soon to be published by the United States Geological Survey.

CABLEGRAMS to the daily papers from New Zealand report the return of the *Morning* which joined the *Discovery* on January 23. The latter ship wintered further south than any previous expedition and Captain Scott with a sledging party penetrated one hundred miles further south than any previous explorer. An extensive mountainous region was discovered, which it is supposed may extend to the South Pole. Two other exploring parties are also said to have made important geographical discoveries. Large collections and numerous observations have also been made. The *Discovery* is expected to return in August.

IT is stated in the London *Times* that M. Bialynitsky-Biroulin, the zoologist, who was a member of Baron Toll's Arctic expedition, has given the Irkutsk branch of the Russian Imperial Geographical Society the following information regarding Baron Toll, who left for Siberia in June last to explore Bennett Land and has not been heard of since. M. Biroulin says that he left Baron Toll at Neupoloch Bay on May 11 and proceeded to New Siberia, where he arrived a fortnight later. He left the island on December 4. Before his departure he erected a hut as a depository for the flesh of thirty reindeer and other preserved food. Baron Toll, M. Biroulin states, left the yacht *Sarja* on June 9 on the islands of the north coast and proceeded to Cape Wyssoki, where he arrived on July 10. Here he deposited a statement to the effect that all was well with him and his followers and that the dogs were in good condition, having had sufficient reindeer meat. Baron Toll started for Bennett Land on July 13 with three sleighs and 45 dogs. If a passage through the ice to the *Sarja* should not be open, M. Biroulin said that Baron Toll intended wintering in Bennett Land.

THE Rev. Dr. John Peate, of Greenville, Pa., known for the reflecting telescopic lenses that he has made while engaged in other work, died on March 24, at the age of eighty-two years.

THE death is announced of M. Gustav Radde, director of the Museum at Tiflis, known for his studies of the natural history of the southwestern Caucasian region.

M. VORONINE, professor of botany in the University of St. Petersburg, has died at the age of seventy-five years.

A TELEGRAM has been received at the Harvard College Observatory from Professor Kreutz, at Kiel, stating that a new star, which is possibly a variable, has been found by Professor Turner, at Oxford. The magnitude was 8.0 on March 16. This object is confirmed on a Harvard photograph taken on March 6, 1903. Invisible on plate and certainly fainter than tenth magnitude on March 1, 1903. A telegram from Professor Geo. E. Hale, at Yerkes Observatory, states that Turner's new star is in the following position. March 27.75 G. M. T., R. A. $6^h\,37^m\,49^s.0$ Dec. $+30°\,02'\,38''$. Its color is red and its spectrum shows bright lines or bands.

THE American Social Science Association will meet at Boston on May 14, 15 and 16.

UNIVERSITY AND EDUCATIONAL NEWS.

THE late Ario Wentworth, of Salem, Mass., has made numerous public bequests, including \$100,000 to the Massachusetts Institute of Technology, \$100,000 to the Massachusetts

Society for the prevention of cruelty to animals and $10,000 to Bates College. The residue of the estate, subject to certain annuities, is to be used for the establishment of an industrial school to be known as the Wentworth Institute. The daily papers state that the estate is valued at $7,000,000.

Mr. Andrew Carnegie has presented to Aberdeen University, of which he is lord rector, nine acres of land as a recreation ground for the students.

Dr. S. M. Lindsay, commissioner of education for Porto Rico, has introduced in the executive council a bill establishing a University of Porto Rico. The institution would be supported by taxation, but it is hoped that it would also receive private gifts and bequests.

Columbia University will on October 31, 1904, celebrate the hundred and fiftieth anniversary of its foundation as King's College.

Representatives from the principal universities and colleges of New York state met on March 26, at Columbia University, to determine the basis upon which the award of the two Rhodes scholarships for New York state should be made. It was decided that in the state of New York the administration and award of the scholarships shall be intrusted to a committee of three, to be elected by the heads of the colleges for men. The committee will consist of President Butler, three years; President Schurman, two years; Chancellor Day, one year. The conference decided that the conditions regulating the award shall be as follows:

> The candidates for the scholarships to be eligible shall have satisfactorily completed the work of at least two years in some college of liberal arts and sciences in the State. Except under extraordinary circumstances, the upper age limit shall be twenty-four years at the time of entering upon the scholarship at Oxford. To be eligible, the candidate shall be a citizen of the United States or the son of a citizen, and must be unmarried.

Dr. D. F. O'Connell, the new rector of the Catholic University at Washington, has arrived in this country and it is expected that he will be installed during the present month.

Filibert Roth, formerly assistant professor of forestry at Cornell University, and later chief of Forest Reservations in the Department of the Interior, has been appointed professor of forestry in the University of Michigan.

Dr. Frederick De Forest Heald, now professor of biology in Parsons College, Iowa, has been elected adjunct professor of plant physiology and general bacteriology in the University of Nebraska.

At Teachers College, Columbia University, Mr. Louis Rouillion has been advanced to the rank of adjunct professor of manual training, and Dr. Maurice A. Bigelow to that of adjunct professor of biology (in charge of zoology).

Dr. Charles W. Shields, professor of the harmony of science and revealed religion, Princeton University, has resigned. Dr. Shields is seventy-eight years of age.

Mr. Robert E. Bruce, now at Pomona College, California, has been appointed instructor in mathematics in Boston University.

Dr. J. Venn, F.R.S., known for his contributions to logic and scientific method, has been elected president of Gonville and Caius College, Cambridge.

The University Court of St. Andrews University has appointed Mr. Bernard Bosanquet, M.A., LL.D., formerly fellow and lecturer of University College, Oxford, to the chair of moral philosophy, in room of Professor William Knight, who has resigned.

Mr. V. J. Wooley, a student of physiology, has been elected fellow of King's College, Cambridge.

Mr. Arthur Edwin Boycott, B.Sc., M.A., has been elected to a fellowship at Brasenose College, Oxford, after an examination in animal physiology.

Sir Michael Foster, M.P., who has held the professorship of physiology at Cambridge since its establishment in 1883, has placed his resignation in the hands of the vice-chancellor.

Professor Laurie, who has held the chair of education in the University of Edinburgh since 1876, has intimated his resignation.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 10, 1903.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE AMERICAN SOCIETY OF NATURALISTS. HOMO SCIENTIFICUS AMERICANUS.**

MEMBERS of a society of naturalists, which includes psychology and anthropology in its scope, are familiar with the part played by rites and ceremonies in social evolution. Millions of holy shrines have been red with the blood of victims, and from countless altars the smell of burnt offerings has risen to heaven, in order that men should be united in closer bonds. We have not broken with the past; we meet together at our annual feast; the lot has fallen on your human sacrifice. Your social service is witnessed by the fact that you do not send him a scape-goat into the wilderness, but come to share his suffering.

The objects of our society, as I understand them, are not the increase of facts and the discussion of theories in each of the natural sciences. Our aim is rather to be

* Address of the president of the American Society of Naturalists, read at the annual dinner, Washington, D. C., January 1, 1903.

a center of organization which shall concern itself with the conditions that are essential to the advancement of science. Our annual discussions and addresses have as a rule treated questions of this character. We ourselves are such a problem. Men of science are the central factor on which scientific progress depends. This is indeed so obvious that we are apt to take ourselves for granted, directing our attention to external conditions that are in fact of far less importance. The remote and the abnormal first attract the curiosity. Psychology is the newest of the sciences and astronomy the oldest, though we really know more about ourselves than we ever shall know about the stars. We are indeed so familiar with the rich complexity of our perceptions, thoughts, feelings and actions that it is difficult to make those artificial abstractions which we call a science. The stars are so far away, atoms are so invisible, we know after all so little about them, that astronomy and chemistry may become exact sciences without contradiction. But if there were as many chemical elements as there are people, the discovery of a new element would be no more important for science than the birth of a new baby in the negro quarter of Washington; if the stellar systems were all visible, the discovery of a new satellite would be of no more interest to the world than the mother's sight of her baby's last tooth. The play of a child for a single day is more complex than the known performance of the stellar universe, and each child changes every day and is different from every other child.

But when the psychologist finds that biology has had the patience to define a million species he may take courage. The differences between individuals or between classes of individuals may be as valid for psychology as are species and varieties for zoology and botany. If it is said that the differences in men of the same race are too obscure and shifting to admit of classification, it may be replied that this can not be settled before an inductive study has been made. If it is said that human differences depend chiefly on the environment of the individual, it may be replied that it is a scientific problem to determine what depends on heredity and what on environment, and that the investigation of the effects of environment may be not less interesting scientifically and more important practically than the study of traits that are beyond control. I for my part do not hesitate to claim that the differences between Shakespere and Darwin are as great as those between *Aspasma minima* (Döderlein) and *Aspasma Ciconiæ* (Jordan and Fowler),* and that it is as nearly in our power to develop an *Aspasma Ciconiæ* (Jordan and Fowler) from the egg of an *Aspasma minima* (Döderlein), as to turn the baby next at hand into a Darwin.

Science is inclined to be somewhat conventional in the subjects it considers, holding fast to an orthodoxy of its own. Once it was a burning question as to how many angels could dance on the point of a needle; now we become equally warm on the subject of the number of species in a given genus. There is no obvious reason why we can not consider with equal propriety how many different kinds of scientific men there are. A tentative classification must precede a study of distribution and life-areas, and when this has been accomplished we shall be in a position to take up the natural history or ecology of men of science.

Following the preliminary work of de Candolle and Dr. Galton, I have for some time been engaged in an investigation of

* "This species is distinguished from *Asparma* [sic] *minima* by the ends of the dorsal and anal reaching the caudal and thus their bases are upon the caudal peduncle; it also differs in the larger number of fin rays." Jordan and Fowler, *Proceedings of the National Museum*, XXV., p. 415, 1902.

the scientific men of the United States. I am selecting a thousand of them for subjects, and have at the same time chosen for similar study the thousand most eminent men in history and a thousand students of Columbia College. Each of these three groups seems to me favorable for such work. The students of Columbia College are measured, tested and observed in my laboratory; we are able to follow their academic courses and their careers in after life. The lives of the most eminent men of history are to a certain extent public property, open to statistical investigation and psychological analysis. A thousand scientific men in the United States would doubtless be willing to assist in furnishing the material needed, which is in any case accessible from other sources. It was at one time my intention to base this address on an inductive study of these scientific men. My reasons for not doing so are similar to those of a friend who was asked why he did not bring his wife to this dinner. He replied that he did not suppose that women were welcome, and besides he was not married. I fear that statistics would be rather out of place and unpresentable on such an occasion, and besides I have not the statistics. I am, however, trying to get them, and not being able to find a more satisfactory subject for my remarks, I must ask your permission to say something in regard to ways and means and such preliminary results as are at hand.

I have been aided in collecting data for my work by the preparation of a biographical catalogue of the living scientific men of the United States, for which the Carnegie Institution has defrayed part of the clerical expense. This additional task has, however, delayed the completion of my work, owing to the increased mass of material that has accumulated. There were on my preliminary list more than 8,000 names, and after those who have not done research work in the natural and exact sciences have been eliminated, there still remain some 4,000 scientific men in place of the one thousand with whom I had intended to deal. It was to me surprising, as well as gratifying, to find that our men of science are so numerous. Brown Goode estimated in 1886 that the number of scientific men in the United States numbered about 500, and Dr. Galton estimated in 1874 that those in the British Islands 'would amount to 300, but not to more.' If these estimates were correct, there has been a noteworthy increase in the number of scientific men, and it appears that the Gauss-Quetellet curve of distribution does not hold for scientific eminence, as we certainly have not ten times as many eminent scientific men as there were in Great Britain twenty-nine years ago. Perhaps we are on the average as competent, and only less eminent because there are so many of us among whom this quality must be divided.

As I have already indicated, our first step in the study of scientific men must be to classify them. Logical classifications of the sciences have been attempted, but with only tolerable success, at least beyond a threefold division into the physical, biological and mental sciences. These divisions are fairly valid—the physical sciences being primarily quantitative and independent of the others; the biological sciences being primarily genetic, but dependent on the physical sciences; and the mental sciences being largely analytic and speculative, but, when properly developed, being both quantitative and genetic, and depending on the physical and biological sciences. Even this broad division, however, must break down —the physical sciences must become genetic and the biological sciences must become quantitative; and the divisions are

interdependent, a science, such as physiology, for example, obliterating the distinctions.

On the whole we may expect to secure the best classification as the result of an inductive study of scientific men. Classifications have, as a matter of fact, resulted from natural selection in the development of scientific courses of instruction, books, journals, bibliographies, societies and the like. I have made compilations of this character, which enter too much into detail to present here. I have also let the scientific men of the United States classify themselves. As a result of this inductive study, but doubtless also under the influence of logical considerations, I have made the classification of the sciences shown on the chart which I have distributed.

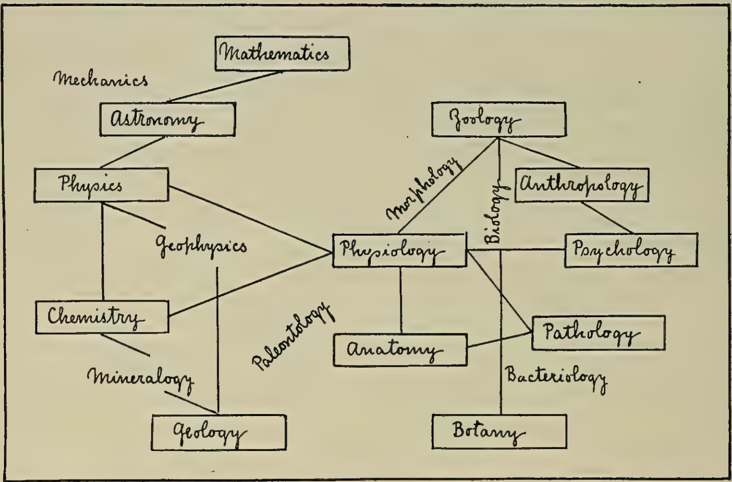

CHART SHOWING THE RELATIONS OF THE SCIENCES.

The graphical representation of the relations of the sciences on a plane turned out to be more feasible than I had anticipated. It must not, however, be understood as intended to assign separate plots to the sciences, but rather to show their complex interdependence and to indicate some of the classifications that can be made. Mathematics, both in its methods and in its relations to the other sciences, occupies a unique position, which can be indicated by placing it above the sciences and nearest to those that are the most exact. Physics, chemistry and psychology are the fundamental sciences on which all the others depend. Physics-chemistry at one side of the chart and psychology at the other indicate this graphically. The facts of matter in motion or energy and the facts of consciousness are more clearly distinct than any other phenomena, while at the same time, being abstractions from the same experience, they are absolutely interdependent. Physical science presupposes perceptions and reasoning, while minds are conditioned by the physical world. Physiology, whether or not life be regarded

as a manifestation of a special form of energy, occupies a central position, forming one triangle with physics and chemistry, and another with zoology and botany. It also forms properly a triangle with the secondary sciences, astronomy and geophysics, and parallels psychology. The great natural sciences, geology, zoology and botany, form a triangle, and their interrelations with the other sciences are indicated with tolerable accuracy by their places on the chart. Anthropology, anatomy and pathology might be included logically under zoology or botany, but owing to their actual development they deserve distinct places. Several other sciences in their interrelationships are indicated on the chart. There might also be entered further to the right sciences such as philology, sociology, history, etc., dependent primarily on psychology, but also on the material sciences. On a plane above that of the chart might be put the applied sciences—engineering, agriculture, medicine, education, etc., each of which rests on a large number of pure sciences, but has specially close connections with one or more of them.

Limiting the scope of this inquiry to the twelve sciences indicated, the men of science of the United States are distributed by various agencies, as shown approximately on the table. On the lower half of the table the same figures are reduced to the common standard of a thousand in each class. Chemists, zoologists and physicists are the most numerous, each group containing about one seventh of our scientific men. About one man of science in ten is a geologist, a botanist and a mathematician; about one in twenty a pathologist and an astronomer. In decreasing numbers then come the physiologists, the psychologists, the anatomists and the anthropologists. It should be noted that the Chemical Society is large, and degrees in chemistry are numerous because chemistry is an applied as well as a pure science. Teachers of mathematics and of the medical sciences are numerous because these are required subjects of study; original contributions are scanty as compared with the numbers of those who teach them.

TABLE I.

THE NUMBER OF AMERICAN MEN OF SCIENCE AND THEIR DISTRIBUTION AMONG THE SCIENCES.

	Special Societies.	Fellows of Association.	Members of Academy.	University Professors.	Doctorates in Five Years.	Contributors to SCIENCE 13 Vols.	Who's Who.	Biographical Dictionary (estimated).
Mathematics	375	81	1	136	61	35	46	380
Physics	149	167	23	105	69	155	73	556
Chemistry	1933	174	12	143	137	73	166	656
Astronomy	125	40	12	41	16	48	51	212
Geology	256	121	13	55	32	161	174	436
Botany	169	120	7	57	53	94	70	416
Zoology	237	146	17	83	72	243	131	620
Physiology	96	10	2	53	18	22	25	156
Anatomy	136	10	0	56	1	13	18	116
Pathology	138	14	5	68	4	44	56	224
Anthropology	60	60	3	4	5	56	37	92
Psychology	127	40	1	37	63	58	21	136
	3801	983	96	838	531	1002	868	4000

REDUCED TO PER THOUSAND.

Mathematics	99	32	10	162	113	35	53	95
Physics	39	170	240	125	128	155	84	139
Chemistry	506	177	125	171	265	73	191	164
Astronomy	33	41	125	49	30	47	59	53
Geology	68	123	136	66	60	161	200	109
Botany	45	122	73	68	99	94	81	104
Zoology	63	149	177	99	134	243	151	155
Physiology	25	10	21	63	34	22	29	39
Anatomy	36	10	0	67	2	13	21	29
Pathology	36	14	52	81	8	44	64	56
Anthropology	16	61	31	5	9	56	43	23
Psychology	34	41	10	44	118	57	24	34

The statistics that I am collecting will give more valid data in regard to the number and distribution of the men of science of the United States than any of the other classes. Next in importance, representing as they do the future rather than the past or present, are the degrees of doctor of philosophy conferred. It has taken during the past five years, in round

numbers, fifty professors of anatomy and sixteen professors of pathology to produce one new investigator; it has taken more than two professors of mathematics or of astronomy to produce an investigator. Each professor of chemistry, zoology and botany has produced one investigator. Psychology has the best record, each professor having produced two investigators. I may be pardoned for referring with gratification to the promise of my own science. The membership of the National Academy of Sciences seems to be the most erratic of the data. Approximately one in twenty of the astronomers and physicists of the country are members of the academy, one in sixty of the botanists, one in a hundred of the psychologists, and one in four hundred of the mathematicians. It is obvious that the Gauss-Quetellet curve entirely fails in its application to the distribution of scientific ability, that eminence may be obtained with much less ability in some sciences than in others, or that some sciences have been favored in elections to the academy.

I am at present engaged, as I have already stated, in a statistical study of these scientific men. I am putting on cards certain data which it will be worth while to summarize. Thus the distribution of men engaged in the several sciences in different parts of the country and its relation to the total population, the relative numbers in large centers, connected with institutions of learning, etc., the comparison of the present location with the place of birth, the education, the ages, the amount of shifting from one institution to another, the rate of promotion, the character and quantity of research, etc., of these scientific men will have a certain interest. This interest will be enhanced and become more truly scientific in character if similar statistics are collected for other countries and for this country at periods of ten years.

This must be left to the future. I am, however, proceeding with work which I trust has a certain scientific and psychological value. I am selecting from all those who have carried on scientific research the thousand whose work is regarded as most valuable. The numbers chosen from each science are in proportion to the total workers in that science. I am asking representatives of each science—selecting those who are most eminent and who are at the same time believed to be familiar with the conditions—to arrange the students in that science in the order of merit. It is obvious that this can only be done approximately. There are diverse lines of research in each science which it is difficult to compare, and there are various ways of contributing to a science which are scarcely commensurable. It strikes some that we are in the condition of the boy at his geometry lesson who when asked what follows when two sides of a triangle are equal replied that all the other sides would be equal too; or of the man who when asked if he did not think the story of the *raconteur* in his anecdote a little broad said he did not think it was as broad as it was long. It is, however, the business of science to overcome insurmountable difficulties; and it is one of the triumphs of science that it can in certain cases measure our ignorance as well as our knowledge.

If the workers in a science are arranged in the order of merit independently by a number of observers, the average position of each can be found and its probable error calculated. Thus we can say that to the best of our knowledge a man stands eighth among our mathematicians and that the chances are even that his real position is between sixth and tenth. The same man might stand eightieth among our scientific men with a probable error of twenty places. The probable errors show that the order of arrangement has validity within

certain limits and tells us what this validity is. The sizes of the probable errors increase rapidly as we go down the list, thus proving some degree of approximation to the theoretical curve, based on the assumption that scientific merit and eminence are dependent on a large number of small causes and giving us the data for the construction of the actual curve.

I am certainly under great obligations to those who assist me in making the arrangements; some find it interesting, others irksome; all show a certain amount of reliance on my discretion. The individual lists will of course be used only for the averages and probable errors, and no record is kept of those who make them. I could doubtless give this address a *succès de scandale* by reading to you the order of merit so far as ascertained, but I have no intention of making public the list until such time has elapsed that each may assume that if the process were repeated he would stand at the head. But while the list may not be published, it is possible to draw from it certain deductions of scientific and practical value. The statistics of the whole number of scientific men have greater interest when compared with those of the more eminent thousand. We can tell whether the average scientific standard in one part of the country, at a given university, etc., is higher or lower than elsewhere; we can give quantitatively, the men being weighted, the scientific strength of a university or department. It would be possible to determine more exactly than by existing methods who should be a fellow of the American Association or a member of the National Academy. It is possible to correlate age, education and other factors with scientific eminence.

The selection of the thousand scientific men who are thought to have done the best work, and their arrangement in the order of merit, are somewhat incidental to my main object, which is to secure a group sufficiently large and homogeneous for scientific study and for comparison with other groups. The problems that are opened and may ultimately be solved are numerous and not unimportant. The old question of the relative contribution of heredity and environment to the making of the individual must for men be solved by a study of men. The infant is more plastic and his surroundings are more varied than is the case with other animals. We may find that the mathematician must be born, whereas the naturalist can be made by a sea voyage. The little scientist can doubtless be made, but probably the great man of science must be born. We have to determine what conditions of both nature and nurture are favorable for the production of usefulness and greatness in scientific work. We should like to know at what age the future of a man can be foretold with a given degree of probability, at what age he has his most original ideas, at what age he does his most efficient work, at what age he is likely to become a public nuisance. We want to know what conditions of health, habits, family, employment, rewards and the like are favorable for scientific performance. In general, we should like to find out how we scientific people differ among ourselves and from others, to make a natural history of scientific men and to use the knowledge for the improvement of the breed.

I have made a small beginning in the direction of getting a scientific description of men of science. At the present convocation of scientific societies I have arranged an anthropometric laboratory in which certain physical, psychophysical and mental tests are being made. These will show how in some fundamental traits scientific men differ among themselves and from other groups.

Certain other traits I am attempting to

estimate and grade. These are shown on the second table. The terms are partly self-explanatory. We know what is meant by physical health and mental sanity and balance. The three next categories follow the analysis of consciousness current in psychology. We distinguish three aspects of mental life—the cognitive, the emotional and the volitional. One of these may be particularly well developed. The man of science must perceive correctly and reason clearly; the artist must have vivid emotions; the statesman or soldier must have a strong will and be prompt to act. These traits are not exclusive of one another, as is usually assumed. The eminent man of science is far more likely than the average man to be a poet or an efficient executive officer. This may be because the traits are correlated, or it may be because the man of achievement must excel in various traits which have been accidentally united in him. This is a question of considerable scientific and practical importance, but one too new and technical for discussion here. I may, however, state that in the Columbia tests we have found a lack of correlation; for example, the man who has a good memory is not more likely than another to be accurate or quick in perception.

The next group of qualities is adopted from my own work in psychology. I have tried to prove by experiment that mental processes vary in time, in intensity and in extensity, that these magnitudes can be measured, and that they are correlated with the time, energy and space relations of the physical world. These fundamental quantitative categories appear to be applicable to character as a whole—a man may be quick or slow, strong or weak, broad or narrow. These qualities seem to me to define and render more exact the four temperaments which are almost the only types of character that have obtained currency. Thus the choleric man is quick and

Table II.

GRADES FOR DIFFERENT TRAITS ASSIGNED TO FIVE MEN OF SCIENCE.

	A.	*P. E.*	B.	*P. E.*	C.	*P. E.*	D.	*P. E.*	E.	*P. E.*	Av.	Av.
Physical health	63	*6*	55	*4*	26	*6*	90	*3*	12	*4*	49.2	4.6
Mental balance	84	*3*	79	*3*	32	*6*	45	*6*	20	*4*	52	4.4
Intellect	90	*3*	57	*4*	79	*3*	38	*6*	49	*3*	62.6	3.8
Emotions	13	*5*	26	*4*	24	*5*	26	*4*	55	*6*	28.8	4.8
Will	90	*4*	45	*3*	49	*4*	63	*3*	2	*3*	49.8	3.4
Quickness	87	*3*	57	*3*	99	*1*	9	*6*	33	*5*	57	3.6
Intensity	82	*2*	25	*4*	76	*3*	57	*5*	8	*3*	49	3.4
Breadth	93	*3*	74	*4*	38	*6*	63	*3*	68	*4*	67.2	4
Energy	98	*1*	32	*4*	90	*3*	77	*3*	3	*4*	60	3
Judgment	96	*2*	70	*4*	30	*3*	30	*5*	15	*6*	48.2	4
Originality	82	*3*	17	*3*	84	*4*	66	*4*	8	*5*	51.4	3.8
Perseverance	96	*2*	30	*4*	54	*5*	87	*3*	1	*1*	53.6	3
Reasonableness	67	*5*	93	*2*	20	*4*	38	*6*	20	*6*	47.6	4.6
Clearness	90	*3*	74	*4*	72	*4*	17	*4*	45	*6*	59.6	4.2
Independence	94	*4*	57	*3*	72	*4*	52	*5*	5	*5*	56	4.2
Cooperativeness	63	*4*	49	*4*	19	*4*	38	*7*	10	*6*	35.8	5
Unselfishness	38	*4*	67	*3*	10	*4*	45	*6*	17	*6*	35.4	4.6
Kindliness	45	*7*	82	*2*	10	*4*	54	*6*	48	*5*	47.8	4.8
Cheerfulness	48	*5*	77	*4*	34	*5*	34	*7*	26	*5*	43.8	5.2
Refinement	52	*4*	72	*4*	8	*3*	4	*3*	63	*4*	39.8	3.6
Integrity	96	*2*	87	*2*	38	*6*	76	*4*	38	*7*	67	4.2
Courage	95	*3*	52	*3*	51	*5*	45	*5*	12	*4*	51	4
Efficiency	100	*1*	57	*3*	74	*3*	34	*4*	4	*4*	53.8	3
Leadership	87	*2*	20	*3*	17	*4*	6	*4*	6	*5*	27.2	3.6
	77	*3.3*	56.4	*3.3*	46	*4.1*	45.5	*4.6*	23.6	*4.6*	49.7	4

strong, the phlegmatic man is slow and strong, the sanguine man is quick and weak, the melancholic or sentimental man is slow and weak. But any one of these types may be broad or narrow, and this seems to be as characteristic a distinction as quickness or intensity. Further, these characteristics may vary in different degrees; the men called phlegmatic are slow, but not to the same extent; they vary more in strength and still more in breadth.

The descriptive terms that follow have been selected from a large collection that I have made and are intended to cover the ground as completely as may be with a limited number. The whole plan is as yet tentative and is doubtless open to improvement toward which I shall welcome any suggestions.

It is my intention to grade and to ask others to grade scientific men for these various qualities. It is not necessary to enter here into details of method. I submit, however, on the table the grades that have been given to five of those entitled to be present at this dinner. The grades were assigned independently by twelve observers acquainted with the men, and have been adjusted and distributed on the supposition that the group of individuals and the distribution of the traits represented average values. The grades are arranged on a scale of one hundred and probable errors are attached. The probable errors, though assigned by the usual formula, are, I think, too small; but they are correct relatively and show which traits are judged with greatest unanimity. We have seen that there are about 4,000 scientific men in the United States. A grade of 100 for efficiency means that the man is thought to stand among the forty most efficient scientific men of the country. A grade of 26 for integrity does not mean that a man is not honest, but that this trait is less marked in him than in three fourths of scientific men.

It may seem unkind, even inhuman, to grade men as though they were prize cattle at a county fair. It is sometimes said that modern science has banished mystery, romance and beauty from the world. But this is not true. The physician smokes too much, the obstetrician falls in love, and even the psychologist makes a fool of himself much as any other man. The rainbow is not less beautiful because Iris has been pierced by the refracted rays from the sun, nor is the universe less grand because Phœbus and his horses have fallen before the law of gravitation and the concept of order. We can not now design cathedrals, but we can build steamships and bridges that are beautiful.

It is our business to make both a science and an art of human nature. As in the physical world we select first the material suited to our purpose, then turn the iron into steel and temper the steel for the knife, so in the world of human action we must learn to select the right man, to educate him and to fit him for his exact task. This indeed we try to do in all our social institutions, religions, commerce, systems of education and government. But we work by the rule of thumb—blind, deaf and wasteful. The nineteenth century witnessed an extraordinary increase in our knowledge of the material world and in our power to make it subservient to our ends; the twentieth century will probably witness a corresponding increase in our knowledge of human nature and in our power to use it for our welfare.

Lest, in spite of sporadic efforts to the contrary, this address makes the impression of a scientific paper rather than of an after dinner speech, I shall conclude with certain speculations which may or may not be upheld by an inductive study. It seems to me that scientific men suffer in character

because they are employees rather than free men. We are not permitted to follow our chosen leaders, but men are placed in authority over us. We are paid to teach or the like; our scientific work must be done almost clandestinely. We do not earn our livings and support our families by the results of our real work; we are grateful if some charity will publish them for us. The pleasure of discovery, fame and honor are supposed to be our reward. Every normal man finds his chief pleasure in doing his work well and with the appreciation of others; but under existing social institutions the value of his work and the approval of his fellows are usually measured by his freedom and his income. The scientific man, seeking the truth without regard to consequence, should be more fearless, simple, fair and kindly than others. In so far as this is not the case, it appears to me to be due to the conditions under which he works.

Evolution has progressed by the survival of the strong and the cunning, of those armed with tooth and claw, of those quick to run and ready to hide. It has given us the vulture and the parasite. Human history has left us the legacy of the iron hand and the crooked back. The man engaged in scientific work has too often filled the position of an upper servant—a tutor to the sons of the rich, a priest subscribing to tenets that are outworn, an employee dependent on the favor of presidents and boards,—for whom silence is silver and flattery gold. As the downtrodden have submitted to servitude on the ground that they will have their reward in a future life, so scientific men have labored in the hope of recognition and posthumous fame. They have scrambled for degrees, titles, membership in academies and the like, trying to climb up on each others' necks. But the things that have been are not the things that shall be. The men who labor with their hands have learned to unite in trades-unions; they have shown themselves ready and able to make the utmost sacrifices for their common cause. And they have won; they have used the governors of states and the president of the United States for their purposes. Their leader can speak to the president on terms of equality; the members of the National Academy of Sciences waited last spring for an hour in the anteroom of the White House until he did them the honor to shake hands with them. Is there a university in the world whose faculty would resign because one member was unjustly treated, or would scientific men subscribe ten per cent. of their incomes to support a faculty that had so resigned? But the things that have been are not the things that shall always be.

Scientific men will not forever submit to being embroidered with gold braid and bound with red tape. The diplomacy and intrigues of courts are slowly giving way to the rough and ready ways of democracy. For a time there may be confusion and some waste; but on the whole there is more promise in the man in shirt sleeves than in the conventional gentleman. I believe that it is our part here in America to form a true democracy of science, where each will do the work for which he is best fit and will receive the reward that he deserves, where we shall choose our own leaders and follow our leaders because we recognize them as such. I am myself an optimist. I am sure that the time will come when scientific work will assume the position that belongs to it. The time will come when there will be peace and good will on earth, and all things will be managed efficiently and in accord with the pure light of reason. I am indeed so much of an optimist that I am glad to live in a period of transition and turmoil, rather than in the millennium for which we strive and suffer.

J. McKeen Cattell.
Columbia University.

*HOW CAN ENDOWMENTS BE USED MOST EFFECTIVELY FOR SCIENTIFIC RESEARCH?**

I am not sure that I have rightly apprehended the special phase which it is desired the discussion should take, if, indeed, it is desired that it should take any one trend rather than another among those that are perhaps equally embraced under the broad theme announced. I have interpreted the question as though it read—*By what assignment of endowments can research be most effectually aided?*

I assume that, with some rare exceptions, endowments may be welcomed in whatever form they may come, but that their effectiveness may be much greater or much less according as they are judiciously or injudiciously placed. Some endowments, indeed, may be so hampered by restrictions that they are better declined than accepted, but these, it may be hoped, will grow more and more rare as intelligence relative to what is wise in the endowment of research increases.

I assume that the principles which control modern success in most other enterprises will be found applicable in general to the endowment of research, and that among these principles are specialization in subject, careful choice of talent, the largest possible use of the highest talent, the greatest possible avoidance of inferior talent, concentration of effort by institutions of limited means and coordination of effort between institutions of whatever means, rising to close combination in effort whenever practicable.

1. *Endowment of Chairs of Research.*—The time is fully ripe for the special endowment of chairs of research. The promise of results from such endowment is very great. Not a few of the chairs in our leading universities are devoted chiefly to research, but this is usually due more to the personal force and peculiar endowments of the occupant than to self-determined provision on the part of the institution or its patrons. The chairs that are endowed primarily for research are very rare. There ought no longer to be a struggle on the part of the capable investigator to free himself from obligations to teach that he may devote himself to creative work. It need not be urged here that creative work is more serviceable to mankind than expositional work or even disciplinary training. Real capability for investigation of a high order being granted, all pressure from the institutional environment should be such as to impel the investigator to give himself as undividedly as possible to research.

The endowment of *chairs* of research is here first urged, not because it is superior to the modes of endowment yet to be considered, but because it requires but a moderate gift, as gifts now run, and is, therefore, within the reach of a large number of possible patrons, to whom endowments in more than six figures are impossible. From $100,000 to $200,000 will effectively endow a chair of research from which great results in time may be expected. Endowments of less amounts may be made to provide that a specific fraction of the time of the occupant of a chair shall be devoted to investigation, and thus creative work may be effectively promoted by a modest sum.

2. *Endowments for Departmental Research.*—No scientific staff of a university should regard itself as fulfilling its mission in any adequate way if it does not devote an appreciable portion of its energies to investigation. At present the provision for research is usually rather vague and

* The annual discussion before the Washington meeting of the American Society of Naturalists, January 1, 1903. Dr. W. H. Welch, of Johns Hopkins University, also took part in the discussion, speaking with special reference to the Rockefeller Institute for Medical Research.

uncertain, if, indeed, there is specific provision for it at all. While research is theoretically recognized as a proper function and is perhaps cordially appreciated by the authorities of the institution, there is in actual practice a constant struggle between the demands of instruction and the desire for investigation, in which the preponderance of pressure growing out of the rapid growth of most universities too often lies on the instructional side. Relief for research is to be found in endowments specifically devoted to the purpose. It is here proposed that the endowment shall be made to the *department* rather than to a specific *chair*. The application of the revenue is, in this case, broader and more plastic than in the endowment of a specific chair. The function of research may be distributed among the members of the staff according to their capabilities and tastes, and thus give to them something of the touch and inspiration of creative work, while they may still retain an instructional function of greater or less degree; or it may be concentrated at one time in a given line by a given member, and at another time in a different line by another member, as conditions may favor. It is not in all cases—perhaps not in most cases—altogether best for the investigator to be relieved entirely from instructional function, since the exposition of his work has its good effect in forcing the organization of his thought. The critical review of it, as he assumes the obligation of presenting it to younger minds, is wholesome, as are also the questions and discussions incidental to such presentation. But the amount of such profitable instructional work has rather severe limitations.

Endowments for departmental research may wisely range through the permutations of six figures into those of seven.

3. *Endowments for Special Research-combinations.*—The early settlers of the broad fields of the interior were accustomed to leave a wide unbroken 'turn-row' along their line fences, and long after the general settlement of the country, these presented almost the only remaining virgin soil. It has been much so in the pioneer cultivation of the scientific fields. Between the recognized realms of physics, chemistry, astronomy, biology, geology and other sciences there is a border-ground which has been less cultivated than these recognized fields, and here lie the richest virgin grounds of the scientific domain. Their adequate culture requires the cooperation of men trained in the several cognate fields. A combination of men skilled in physics, astronomy and mathematics is essential to the highest results in astrophysics. An association of men skilled in chemistry, physics, mathematics and geology is requisite to the most promising attack upon the complicated problems of geophysics, and so of other border-grounds. There is, therefore, an eminent opportunity to promote research by endowments which shall provide for the cooperative investigation of two, three or more men whose combined talents and training may fit them to engage jointly in a common inquiry. The endowment here must be large to be effective, but where it can be made adequate, its promise of fruitage is most eminent.

4. *Endowments for Schools or Colleges of Research.*—This is but a larger phase of endowments for departmental research, but with this difference: in the latter it is presumed that the departmental staffs of universities will continue to be, as at present organized, primarily for instructional work, while in the proposed endowment of schools or colleges of research it is presumed that research will be the dominant feature and instructional work will be incidental. Very great creative results would flow from the judicious establish-

ment of schools of research in chemistry, physics, biology, geology and other sciences analogous to the staffs of astronomical observatories where investigative work is now the declared purpose.

In the initial stages of the development of this scheme it is assumed that these schools of research must be individual and localized in different institutions, since no institution does now, or probably can in the immediate future, command the means for the establishment of such schools in all the departments that invite investigation. But if one institution were to concentrate upon one science or one limited group of sciences, and another institution upon another science or limited group of sciences, the universities of the country might *together* cover the field effectively. It were much better, to my mind, if the aspirations of a university should take a definite specialized form of this kind in some one or some few lines, than that it should distribute its effort over all lines with inferior success in each because of its limitation in men and means. It is probably not beyond the resources of any great university to secure the development of some one or two effective schools of research if it were content to make a selective effort and were wise enough to do this.

5. *The Evolution of Universities into Assemblages of Research-schools.*—Ultimately it is to be hoped that each of the greater universities will succeed in developing a large group of research schools, and that with this there will come a gradual reorganization of the constitution of universities, involving their transition from the function of personal education to the higher function of creative work. The English universities are now essentially aggregates of colleges, each of which is mainly devoted to personal education. The ideal of a university, as here entertained, would make the coming university an association of colleges of research for the benefit of mankind as a whole. In the English university, the several colleges cover essentially the same ground and are duplicative in their work and competitive in their relations. In the ideal university the colleges would occupy distinctive fields and be supplementary and stimulative toward each other and in no sense duplicative. Their primary function would be creative work for all mankind rather than didactic or disciplinary work for individuals.

6. *Endowments for Independent Institutions of Research.*—The preceding discussion has related essentially to universities. Aside from organizations under governmental patronage, universities are at present the chief agencies of research. It is doubtless quite within the truth to place to their credit by far the largest amount of creative work done independently of government patronage. None the less there is, to my view, a large and special place for independent institutions of research and endowments for such independent institutions are invited by their promise of fruitfulness. Every university has its special relations with some portion of the social organism by which it is fostered, and to which, because of that fostering, it is in special bonds. While this relationship of support and consequent bondage is one of greatly preponderating good, it is not without its moiety of trammeling and limitation. In order to fill out the full complement of institutions suited to the most effective promotion of creative work, a class of institutions not subject to these relations is needed. These needed institutions might, indeed, likewise have their own special relationships with their own limitations and trammelings, but they should none the less fill a place not occupied by existing universities, nor likely to be occupied by them. More than this, these

independent institutions of research should stand in relations of wholesome competition to the universities, and by representing a different phase of endeavor should thereby contribute to the broadening of the sum total of influences at work for the promotion of research.

7. *Endowments for the Higher Coordination of Research.*—Whatever may be the development in any of the institutions to which the phenomenal generosity of American men of means has contributed, or may yet contribute, it must still remain true that for an indefinite time the whole field of research can not be effectively cultivated by any institution, and there must be large need for adjustment and cooperation, that the energies of research may be distributed to the greatest advantage. Even if it were possible for any institution reasonably to attempt the whole field, cooperation and coordination in research should be cultivated to prevent wastage by unnecessary duplication and to give the greatest and best results by the adjustment of work to work. At the present stage of development, provision for cooperation is eminently desirable and endowments devoted to this end give promise of being preeminently productive. The ideal scheme of coordination contemplates the correlation of talent and equipment in all the institutions devoted to research without regard to institutional relations. It should be as free as human nature may permit it to be from predilection toward one form of institutional organization rather than another. It should be its function to develop, to use and to coördinate talent, effort and equipment wherever it may be, quite regardless of institutional connection, or locality, or of other relations than its possibilities of fruitfulness in creative work.

It need not be remarked here that we seem to be on the threshold of this great realization, and it is not too much to hope that each of the other forms of endowment will, in some large measure, appeal to the phenomenal generosity and appreciation of American men of wealth.

T. C. Chamberlin.

I will confine my remarks to the question as to the most effective use of endowment for the publication of scientific work.

While in Europe, particularly on the continent, we find numerous publishers who undertake the publication of scientific works and periodicals as business ventures, there is no such publication known in our country, except in the applied sciences or in so far as books can be used as text-books. All work in pure science that is published in our country is published by the help of edowment of one kind or another.

It is not quite easy to determine the reason that has led to this state of affairs. It may be due partly to the newness of science in America, partly to the great cost of printing, and partly to the limited number of buyers of scientific books; but it seems also probable that the vast amount of scientific publication carried on by our government, and the lavish distribution of its publications have discouraged private enterprise.

The United States government and the state governments are the most liberal supporters of scientific publication. Next in importance are the scientific societies which are distributed all over our country. Third in order are universities and other institutions of learning; and, finally, wealthy friends of science. The total amount of money invested annually in scientific publications is quite considerable. A comparatively insignificant part only comes from that part of the public which purchases scientific publications on account of their contents. From an economical point of view this is an abnormal condition; and the question arises, whether

the method of scientific publication can not be so improved as to make the available funds more effective, and to secure the support of libraries and of private individuals who make use of scientific publications.

Setting aside the publications supported by the government, scientific publications may be roughly divided into journals devoted to special branches of science, special memoirs supported by scientific societies or institutions, and miscellaneous serials supported by general societies, such as academies of sciences and museums. Among these the only class that is entirely, or at least almost, self-supporting, are the special technical journals, which appeal to a well-defined group of people that constitute a society supporting the journal, or which are published by a few individuals and pay the cost of manufacture through subscriptions. The second and third classes of publications are almost entirely supported by voluntary contributions, not by the public that makes use of them. If it were feasible to readjust the conditions of publication in such a manner as to create a market for the publications here referred to, the facilities for publication would be materially increased, the available endowment would be made more effective, and the claims for more liberal financial support would become justifiable.

It seems to my mind that the traditional policy of societies and other scientific institutions to publish serials devoted to miscellaneous subjects is, to a great extent, the cause of present conditions, and that by proper cooperation between such societies and institutions many of the difficulties under which we are laboring might be obviated. At the present time numerous academies of science publish volumes of transactions, proceedings, annals, etc. Most of these publications are not strong enough to command the support of the scientific public. They find their way into libraries of other societies by exchange. They are sent to the members of the society that publishes the serial, but they are not read by them on account of the miscellaneous character of the publication. For this reason the serials of most of our mixed societies have come to be an excellent means of burying good scientific material. They are not read; they are placed on the shelves of the libraries of societies, which, on the whole, are unable to make their books accessible to the reading public. There are, therefore, two points of view from which the present method of publication may well be criticised. The one is that the material is combined into volumes in such a way that an exceedingly small part of each volume only is useful to the student of a particular branch of science. The second is that these serials find their place, not in important libraries, but rather in small libraries of societies, where it is very difficult to consult books.

This method of distribution is also a survival of conditions which may have been desirable in former times, when there were no great public libraries, and when the scientific society had to perform general educational functions, among them that of maintaining a reference library. At the present time this need is well taken care of by various kinds of public libraries, so that it may well be doubted whether, at least in most of our larger cities, it is worth while for societies to continue the accumulation of books. As a matter of fact, the method of building up libraries by means of exchanges is one that does not seem to fit well into our economic conditions. In all other walks of life the acknowledged medium of exchange is money, and we measure the equivalent of an exchange by this standard. In building up

society libraries we are content with spending money on publications and taking in exchange for them, not what we want, but whatever we happen to get. In consequence of this, the editions of society publications are too large, and the libraries which are accumulated are of little practical use.

These conditions might easily be remedied by a proper cooperation between the societies and institutions of our country. If the total output of scientific matter produced by our smaller mixed societies could be combined and arranged in serials, each covering one of the important branches of science, it would be possible to provide a number of scientific serials, each of which would be of sufficient importance to command the attention of scientists, and which for this reason would have to be taken by some group of men who subscribe for the special journals, and also by all the larger libraries of our country and abroad. A demand for these publications would, therefore, at once be created, and the material that is now difficult of access would become available to all. The society funds devoted to publication would be relieved by the increased subscriptions, and the publication work would, therefore, become much more nearly self-supporting than it is at the present time.

At present the mode of bookkeeping of scientific societies is such that the charges for publication and for accessions to the library are not separated. This is due to the fact that the accessions to the library are paid by exchanges. If in the bookkeeping of societies these two items were clearly separated, it would be found that the amount of money invested annually in the library is entirely out of keeping with the usefulness of the library, except in the few cases of old societies which own houses and sufficient funds for the proper administration of books. In all other cases it would seem more advantageous to discontinue the accumulation of books, and leave this branch of work to public libraries.

The only difficulty in organizing the work of publication in this manner lies in the reluctance of societies to lose any of their individuality and to become closely associated with a larger body; but scientific societies and institutions should recognize the value of cooperation and the fact that the advance of science will be best promoted, not by selfish endeavor to aggrandize each society, but by willing association with others and by cooperation towards a common goal.

If the publication work of societies and institutions were organized in this manner, the serials would, to a greater or less extent, be similar in form to the scientific journals described before. On the whole, it may be said that these journals offer an adequate means for the publication of short papers. It would, therefore, seem appropriate for the mixed societies to devote their energies rather to the publication of memoirs that are too extensive for the journals. Such series of memoirs might well be made supplementary volumes of the special journals, and in this way a unification of the whole subject-matter devoted to a certain branch of science might be brought about.

There is another field in which cooperation might result in much more satisfactory arrangements for the advancement of science than those we have at the present time. Various journals and society publications print in each number a selection of notes, bibliographies, reviews, etc., which to a considerable extent overlap. The preparation of reviews is more or less left to chance, and the attempts at systematic collection of bibliographies are few. Nevertheless, we all recognize that systematic reviews and bibliographies are sorely

needed by students. It might seem that through cooperation of technical and mixed societies such bibliographies might well be prepared, and that in connection with their serials each group of societies might undertake the preparation of a *Centralblatt*.

These considerations make it clear that a vast saving of money and energy may be effected by the proper coordination of the work of mixed societies, and that the publications may be made infinitely more effective. Such coordination would require a certain sacrifice of independence on the part of each society, which would be amply repaid by the greater usefulness of its work. I think, if we succeed in moving on in the direction of thus centralizing effort in every branch of science, we shall be justified in asking for more liberal support of our work, not so much by endowment as by enlisting the interest of friends of education who will support the work of libraries by subscribing to scientific serials. If all the libraries in our country that have more than ten thousand volumes were in a position to subscribe to the organized scientific periodical literature, there would be no difficulty in providing for the publication of the bulk of all scientific matter worthy of publication, and without asking for heavy endowments. There would still remain a number of special and costly works which societies and institutions could not well support out of their own funds. For such publications we might justly ask the assistance of wealthy friends of science. For these we should try to obtain sufficient endowment, which might be allotted by a national council representing the various branches of science.

I thoroughly believe that our first duty is to systematize our efforts, and to economize by such systematization. In this way we shall make the available funds go much further than they have ever gone before. We shall make our work more effective, and enlist the cooperation of the reading public, and we shall be in a position to ask with greater authority for the support of publications that neither the government, nor societies, nor the reading public is able to support.

Franz Boas.

On the principle that it is sometimes important to know what not to do, I would offer a few remarks on one of the practical aspects of the inverted question: How are we at present using endowments ineffectually in scientific research?

To those who see our fires of learning gleaming only from afar, and are not near enough to see all the smoke, many of our university customs must appear to be enveloped in a haze of sanctity. One of these is the esoteric custom of awarding fellowships for research. In the language of the apiculturist, a university fellowship seems to the uninitiated like a rich mass of 'royal jelly,' to be fed to some fortunate but impecunious larval investigator for the purpose of enabling him to develop into a leader in the hive of scientific workers. And very often the larval investigator is of the same opinion till the food is administered and he suffers the disillusionment of the initiated.

He is no sooner awarded a fellowship of a few hundred dollars—and this is true even in our most richly endowed universities—than he finds that half or the greater portion reverts to his benefactor for tuition and laboratory fees. Nor is he even then permitted to settle down to his work in peace with the small pecuniary remnant and the 'honor' thereto appertaining. He may find that the richer the institution, the more it has need of his services as an instructor or laboratory assistant. This is because the university has

committed itself to what for want of a better term I shall call the 'lunch-counter' policy of perpetually offering new courses and subjects—not so much, perhaps, for the purpose of keeping pace with the multiplying and advancing sciences, as for the purpose of keeping itself constantly before the eyes of the public. One heavily endowed institution is known to have utilized its fellows as attendants in the departmental libraries, because the expensive 'lunch-counter' policy would not enable it to pay the salary of departmental librarians. And it is not impossible that somewhere between Maine and California there may be universities so heavily endowed that they can require their fellows to perform regular janitorial services.

With the insignificant remnant of his fellowship and such scattered remains of his faculties as can be scraped together from the more or less perfunctory study of one or two 'minor' subjects, and from the neglect of his duties as a sort of poor relation in the university household, the fellow is supposed to be 'doing original work,' 'making researches,' 'investigating.' If he was a child with strong investigating impulses, like all normal children, and has retained a shred of these ancient and pithecoid, but nevertheless divine, impulses after running the gauntlet of some of our secondary schools and colleges, he is expected, under the limitations afore-mentioned, and while eating any thing and living in any way, to produce some epoch-making work *ad majorem universitatis gloriam.*

As a matter of fact, the poor fellow—and he is, indeed, a poor fellow—is given some problem which to the body of his chosen science bears about the same proportion as a single nucleus to the whole human body. He proceeds to collate all that Schultze, Mueller, Schmitt & Co. have written on the subject, glues it together with a little of the secretion from his own larval sericteries, and prepares his jaded nerve-centers for the final examination farce. His professors assemble, and, bereft of all sense of humor, instead of smiling at one another like a troop of Roman augurs, sit through the farce with faces as long and as blank as the windows of the favorite-imported-imitation-Gothic-university-architecture—that gingerbread relict of church-ridden mediævalism—till the candidate wriggles through with a *rite* or a *cum laude,* or perchance, if he has been sufficiently intrepid to mount to sources unknown to his professors, with a *summâ cum laude.* And the newly-fledged doctor goes forth into the country to start a fresh center of mental infection of the same old type.

It would, indeed, be difficult to devise a more effectual method of hampering research than by the petty restrictions placed on fellows in most of our universities. Such, among others, are the pusillanimous objections to permitting fellows to work *in absentiâ* or where they can best obtain their materials, consult the best libraries and museums, work in the necessary marine laboratories, botanical gardens, etc. The results of these restrictions, so far as American biology is concerned, are only too apparent in the monotonous output, the few lines of investigation that are being intensively cultivated, and in the not infrequent cases of intellectual parasitism and commensalism, not only on the part of the students—that is to be expected—but between professors of different institutions. In the meantime the whole of tropical America, as well as the tropics of the Old World, abounding in materials of the greatest interest, not only to the botanist and the zoologist, but to the paleontologist, geologist, mineralogist, archeologist, anthropologist and pathologist, are being rapidly opened up to us. For any adequate utilization of such magnificent opportunities,

and in view of the fact that our gilded youth show little inclination to indulge in anything so tame as research, we must have fellowships of some kind, but fellowships with no niggardly academic restrictions. Our young men should be enabled to spend months or even years in localities where they can study organisms in their natural environment. The prevalent type of university expedition, that hurries through a country, collects a few miscellaneous specimens and observations and makes for home, may be better than nothing, but it leaves us little the wiser concerning the most important problems presented by the fauna and flora of foreign countries. Stuffing our museums with specimens is not necessarily advancing biological science. And it is not even necessary to call attention to the tropics in this connection. Vast stretches of our own country are all but unknown biologically, and are liable to remain so as long as our graduate students and fellows are persuaded that the salvation of the science depends on their becoming sessile organisms with *idées fixes* on the twinkling of the centrosomes, the twiddling of the chromosomes and a few other matters of similar import.

I am aware that much of what I have said may belong to past history, and may even apply to men of straw, but there is still a good deal of old straw, or what the Germans call 'Zopf,' in all our universities. Some of this is undoubtedly of our own cultivation, but much of it has come to us in the packing boxes with intellectual commodities from Europe. The sooner we set fire to it the better.

I would venture, in conclusion, to advance the following suggestions as a remedy for some of the evils connected with our fellowships:

1. Let us select as fellows only those young men who have well-developed investigating instincts and the proper preparation, maturity and mental balance to apply themselves perseveringly to the business of research.

2. Let these young men be given sufficient monetary aid to detach themselves from an inadequate environment and to do their work wherever they can find the best facilities, in America or in any other portion of the habitable globe.

3. Let us understand that a fellow is not a recipient of alms, and that he is not only honored by the university, but confers an honor on any institution with which he may become connected in the capacity of investigator.

4. Let us have sufficient knowledge of human nature and the historical development of the sciences not to expect immediate and inordinate scientific returns for any pecuniary aid which we may be able to bestow.

William Morton Wheeler.

It is very gratifying to note the constantly growing interest in scientific investigation in all parts of America. To this many agencies have contributed. Among them the universities and experiment stations of the government, both national and state, naturally come into the mind as the principal institutions by which research has been fostered. Endowments placed in their hands have been in almost every case wisely administered. Research, however, has not, in any American university of the first rank, been definitely put forward as of primary importance. It has been compelled to conquer a place for itself and show its right to consideration under the university organization. I am not sure that in some instances research in the universities has not been something of a 'fad.' It has been sometimes put before immature and naturally incapable persons as the only goal for their

endeavors. As a result considerable misdirected effort has no doubt been made, and in a certain sense it is to be deplored that the grade of investigation in American institutions has not been higher than it is. The important point is, however, that the universities and colleges have felt the necessity of going beyond the work of formal instruction, and time may be expected to correct the errors and inadequacies of their efforts in investigation.

I view with some degree of pessimism all suggestions concerning cooperation in research between different institutions. I do not mean by this that no cooperation is possible, but in many instances cooperation means subordination, and is one step in the decline of institutional research. It seems to me that institutions are very much like individuals, and that the important thing is to have as many as possible of them take up the work of research and carry it forward to the best of their ability. The principle of natural selection will work among them towards the elimination of the weaker and unfit. It does not seem to me that institutions for research or avenues of investigation have been so greatly multiplied in the United States that the time has now come for combining or 'mergerizing' them. On the contrary, one should view with enthusiasm the addition of new institutions and foundations by means of which scientific investigation may be more universally developed throughout the country. The situation in America is such, if I read it right, that *results* of research in the discovery of the laws and forces of matter are, after all, not so essential as the *spirit* of research disseminated throughout the nation.

It would seem that in society there is some automatic mechanism at work by means of which emergencies, as they arise, are rightly met. There comes a man for every hour, whether its burden be great or small. Generally speaking, I believe that research in America has developed naturally and reasonably to its present respectable proportions. The great foundations, whether they be universities or learned societies, private or governmental, have shown the higher social wisdom and have done their part, unconsciously perhaps, but none the less excellently, in the development of true science and genuine research. Boards of directors may generally be trusted to use endowments up to the level of the intelligence of their community and generation.

I favor the multiplication of institutions and agencies for research. They should be untrammeled and free to work out their own destiny. Every new foundation should be welcomed and should be permitted to stand or fall as it may show strength or weakness. Experience will be the only teacher of its board of directors and results the only criterion of their success in administration.

Conway MacMillan.

The president of the Society of Naturalists has kindly invited me to represent the psychologists in our discussion. I suppose his idea was that I should formulate some endowable plans for psychological researches. But that has been done, perhaps even overdone; modest and luxurious, possible and fantastic plans have been outlined, sufficient for the psychologists of the whole century, and I have had my full share in it—I felt unwilling to fish in those waters once more. And yet that was the thing to do if I understood and interpreted our president correctly; there was only one chance for me: I might try to misinterpret and to misunderstand his invitation and with this intention I accepted it.

I thus misunderstood my task to mean that I ought to consider the whole problem of research and endowment as a psy-

chological phenomenon, and I can not help it if my psychology has even a certain national flavor; the president knew that my views as well as my English are 'made in Germany.'

I, for one, indeed, believe that, if the improvement of scientific research in America is under discussion, the psychological factor which is involved can not be emphasized too strongly; it is the *psyche* of men and not the physical apparatus that determines the value of research. I know very well that work in a rich laboratory is much more comfortable than in a poor one, but the ultimate productiveness of the research does not depend upon it. Wherever good productive work is done, there is a strong moral claim for greater comfort in work, for greater leisure, for finer devices to make work more effective, more elegant, more complete, but the essentials of research are not touched by these factors. In the sphere of research, as in all spheres of life, there is a dangerous temptation to take greater comfort in itself for greater culture and internal progress. The whole history of science suggests the opposite. Everywhere may we see that the decisive discoveries and experiments were made with modest means and clumsy apparatus, and the change from poverty toward luxury has not seldom meant a change from concentration to superficial expansion. The great Helmholtz once said to me: "In the small laboratories with home-made apparatus they mine gold, while in the large and rich ones they transform the gold nuggets into sounding brasses."

How little important is the equipment is shown just by the situation in this country. It is an insufficient excuse for unproductiveness if the fault is laid to the defective equipments. If the outfit and the means were the determining factors we Americans should be far ahead of European research in many fields. In my own science, experimental psychology, the commercial value of the equipment of the existing psychological laboratories in America is perhaps five times greater than that of all German, yes, of all European, laboratories, but it would be absurd to say that we have really done five times more than those on the other side of the water. The real foundations of our science were laid by Professor Wundt in a German laboratory whose equipment is surpassed to-day by many frontier colleges in this country. And I deny that my science is an exception. In zoology, for instance, there are small colleges here whose names are hardly known, whose equipment surpasses that of universities like Leipzig, and yet, as the poet says, what difference to me!

The only two factors which really count for research are to be found in the minds of the men; they are, first, intellectual quality, and secondly, the will to achieve. These are the two respects in which American research is defective. Have we the right kind of man behind the gun?

The psychologist must ask, of course, in general: Is the right kind of research man to be found at all among this people? I should say: Certainly—perhaps nowhere a more ideal combination of the right features. Quick, sharp grasp of a situation, brilliant inventiveness, persistent energy, talent for organization, unselfish idealism, all these are characteristics of the best type of American and exactly these are the conditions of successful research. The misery of the whole situation is that if we abstract from the numerous exceptions and look on the broad average, this right type of man sits in the counting-houses and law offices, is busy in commerce and industry and politics and medicine and what not—but into the graduate schools and into college work there rushes, together with

some excellent men, the swarm of good modest fellows without much ambition and talent—and rushing is still too energetic a word; that type of man does not rush, but is passively moved forward. Everywhere in this country the average graduate student who prepares for academic work represents as to intellectual energy a lower type of man than the average undergraduate, and yet with second-rate men there can not be a first-rate science, even if a billionaire comes to them, as Jupiter came to Danæ, in the form of a shower of gold.

But why do our finest men shrink away from the career of the scholar, which is sought, in Germany for instance, by the very best: simply because it does not sufficiently stimulate their ambition. There are not the great premiums at the top, and it is well known that in the eyes of youth every career gets its social value just from chief premiums and exceptional gains. The career ranks here with the humble one of the schoolmaster; how can it stand in competition with banking and law? Thus I should say to those who have millions ready for endowment: first make the career attractive, so that it can tempt more men of the first-class type; create great premiums by putting above our present university system a still higher institution, an over-university where the finest masters of research in every field, chosen by their peers, are brought together for far-reaching work which transcends the possibilities of the educational institutions. Whatever you can do to give to the career national glory thus to attract the finest men, will be productive for the work of research.

But I add a second point. From one motive or another a lot of fine men enter the career already to-day, and yet even they do not live up to their best. As I said in the beginning, it is not only a question of capacity, but one of concentrated will to achieve. Even our good men, while they start with high intentions, too often give up after a short beginning; the spirit of research evaporates and the routine teacher remains. I know that there are plenty of external reasons, too many are overburdened—and yet, the chief reason is again a psychological one; there is no stimulus for productive scholarship. They feel too soon that such achievement does not count for their career, yes, that they have to stand below the man who spends his time in mere teaching and administration. Make the academic career in the real universities, the promotion to higher positions, dependent in first line upon research work, as it is in Germany, and the work will be done, in spite of all obstacles. There is at present no greater educational need in this country than to educate the trustees of the universities. Everywhere, with a few exceptions, the universities are still administered after the pattern of college administration, and the research spirit is thus artificially suppressed. Let the trustees understand that research can grow only where it is considered as the backbone of university life, as the condition for appointments, and that only scholars, not laymen, can be judges for it; then we shall have research which will keep pace with the marvelous progress of this country. And to my billionaires I should say: Help us to bring about this change; endow with your treasures those existing universities which show the right appreciation for productive work.

I have so far expressed dissatisfaction with the existing conditions; are there no psychological conditions which are favorable here for scholarly work? Certainly, above all, one most important one—the spirit of helpfulness and ambition in the special academic communities, the readiness of the alumni to stand for their Alma

Mater, to push forward her work and her equipment, to make it strong in the rivalry of the various institutions. This local academic pride has secured the progress which the last decades have seen: here lies the one great advantage which the American institutions have over the German universities, which have to await everything from the governmental center. Thus, if we desire that this noble progress shall go on, by all means do not tamper with this local self-activity by giving favors on application. Do not undermine it by central interference; do not annihilate that feeling of responsibility among the alumni by playing providence. Your good-will would be merely an opiate for the energies of the communities; they would soon leave the whole care to you, and matters would then be worse than before. The only help for the individual researcher which is not to paralyze the eagerness of the community, must come either through the medium of the institution to which he belongs, or from central establishments which shall benefit all alike. For instance, we badly need large printing houses which shall print scientific matter for every one without profit, or mechanical establishments for cheaper apparatus, as in such respects we are really worse situated than Europe.

Furthermore, a patchwork of scattered favors will not only ruin those forces which work for good to-day, the enthusiasm of the alumni, but it will be harmful even to the workers themselves. Firstly, it introduces a central power without self-government: we may have the most ideal men in control, and yet the door would be wide open for all the bad features of the spoils system and favoritism, because in questions of research the decisions must remain dependent upon the prejudices of scientific cliques and schools. We do not want academic party machines and party bosses; we do not want wire-pulling for one scientific school as against another; there are too many alarming reports afloat already. There may be discussion whether state life prospers better with self-government or with paternal autocracy, but there can be no discussion which of the two systems is the better for research and scholarship. Research needs free competition.

But worse than the absolutely unavoidable arbitrariness of the distribution must be the moral effect of the system on the researchers who are favored. The charity system is nowhere more tempting, but just, therefore, nowhere more ruinous than in the republic of scholars. Charity hides the problem but can not solve it. Alms for research, tendered on application with pledges for good behavior and typewritten manuscript, will do what the economists everywhere find as the results of mere charity. Instead of building up the community it will weaken it. Charity is everywhere the easiest way out of a difficulty, because it leaves the real difficulties to those who come later. In the first moment you hear a thousand God-bless-you's and after a little while the energies are emasculated. Research ought not to go begging, research wishes to be free; research wants respect, not clemency; its rights, not favors. Research desires the improvement to come from within, not from without; by applying endowments not according to the principles of politics, but according to the principles of psychology, trying to raise the average type, trying to stimulate everybody to his best work, and trying to create better conditions for all alike; in all these three respects endowments might work wonders.

HUGO MÜNSTERBERG.

HARVARD UNIVERSITY.

SCIENTIFIC BOOKS.

The Influence of Light and Darkness upon Growth and Development. By Daniel Trembly MacDougal, Ph.D. Published by the aid of the David Lydig fund bequeathed by Charles P. Daly. Memoirs of the New York Botanical Garden, Volume II. New York, 1903. (Issued January 20, 1903.) Large 8vo. Pp. xiv + 319.

This notable contribution opens with a short historical account (34 pages) of investigations bearing upon the subject under consideration, the earliest of which was that of John Ray in 1686, followed in 1727 by Hales, in 1754 by Bonnet, in 1776 by Mees, in 1782 by Senebier, and in 1783 by Tessier. This brings the record down to the opening of the nineteenth century, in which we find seventeen names in the first half, among which are DeSaussure (1804), DeCandolle (1806), Davy (1815), Knight (1841), Payer (1842) and Draper (1844). Shortly after the middle of the century Sachs began his work (1859), and continuing for thirty years or more, added 'an enormous number of facts concerning growth and the relations of light to plants,' and 'led the way to nearly all of the modern work upon this subject.' No doubt he revolutionized this part of the science of plant physiology, and yet it is a curious fact, as Dr. MacDougal remarks, that 'scarcely a single one of his conclusions concerning etiolation and the influence of light upon growth is tenable at the present time except in modified form.' Stimulated by the work of Sachs, a host of investigators sprang up, their number increasing rapidly during the closing quarter of the century. The latest names recorded are those of Ricome and Noll (both in 1902), immediately preceded by Livingston, Goff, Wiesner, Nabowick, Neljubow and Schulz (all in 1901).

The body of the book (166 pages) is made up of careful records of observations upon ninety-seven different species of spermatophytes and pteridophytes. Here, as one reads page after page of observations, it is made very plain that this portion of the book required a deal of patient work. By means of drawings made from photographs the text is helped out and made much plainer than would have been possible otherwise. The earlier work was done by the use of small portable dark-chambers of zinc or wood, but after the removal of the author to the New York Botanical Gardens in 1899 a specially constructed room in the middle of the museum building was used. Here the temperature was very constant, and a normal atmosphere was secured by proper ventilating apparatus. Entrance to the room was through double doors with a vestibule between, and the plants under observation were examined by means of a single-candle or a four-candle power electric lamp.

As a matter of course, the most obvious result of the growth of plants in total darkness, aside from the loss of green color, is the more or less complete suppression of the leaf-blades and an elongation of the internodes of the stems. There are also marked changes, which, however, are not readily seen, in the minute anatomy of the leaf and stem, as are well shown by many excellent figures. In some cases the histological changes are quite remarkable, as in the leaf of *Oxalis lasiandra,* the stems of *Galium circæzans* and a seedling oak. The epidermis of *Opuntia opuntia* shows very striking differences, as is the case to a less degree in most plants observed. Here, however, while the epidermal cells are usually much modified, the stomata themselves are but little changed on the etiolated leaves. Among the interesting modifications figured, none are more so than those of the 'pitcher leaves' of species of *Sarracenia.*

In a discussion of the effect upon the plant of prolonged or continuous light, the author concludes that "increase in the total duration of illumination to which a plant is exposed, during its vegetative period, either by artificial nocturnal illumination, or by cultivation in Arctic regions, results simply in a correspondent acceleration of the seasonal development of the plant, by which a greater amount of work is accomplished within a given number of days. The extinction of the daily 'resting period' brings no distinct reaction so far as important anatomical features are concerned, although an exaggerated produc-

tion of certain substances is found to take place. Neither is any retarding or paratonic effect to be seen as a result of this continuous illumination."

The chapter on the theories as to the nature of etiolation is curious and interesting. The theories of the earlier investigators quite naturally were very crude, and it is not too much to say that something of this crudity continues even to the present day. Apparently we are not yet ready to formulate a satisfactory explanation of the action of a plant when grown in darkness. The 'adaptive theory' of Boehm (1886) as elaborated by Godlewsky (1889) appears to be the one most favored by botanists just now. It interprets etiolation as a direct adaptation, and assumes that 'the attenuation or elongation of axial organs is a means of lifting chlorophyll-bearing organs past theoretical obstructions.' Of this the author says, however, that 'the forms presented by the shoots of a greater majority of the species examined do not exhibit any beneficial adjustments by which the plant might free itself from encompassing darkness, and lift its leaves and reproductive organs past the obstruction that intercepts the rays.'

We should like to refer to the chemical composition of etiolated plants, the rate and mode of growth of such plants, the stimulative influence of light, etc., taken up in this most interesting book, but space forbids further discussion at this time. The author is to be congratulated upon having added so valuable a book to the growing list of his publications.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

International Catalogue of Scientific Literature, first annual issue, R—Bacteriology. Published for the International Council by the Royal Society of London. London, Harrison and Sons, 45 St. Martin's Lane. Vol. VIII. December, 1902. Pp. xiv + 314.

This is a comprehensive bibliography of books and other contributions to bacteriological literature which appeared during 1901. Author and subject lists are given, the latter arranged according to a decimal system. The plan and essential features of this undertaking, which is an outgrowth of the 'Catalogue of Scientific Papers' formerly published by the Royal Society of London, have already been described in SCIENCE, N. S., Vol. XIV., p. 861. In the present issue there are 2,206 titles indexed under the authors index and presumably the same are grouped under the subject classes. To cover the literature of any scientific subject in all languages is a stupendous task, and for those who use the catalogue it will doubtless be found a valuable aid. While it is always easier to criticise than to construct, yet there are certain features of the present volume to which attention deserves to be called.

Exception could be taken to the admission of articles on malaria, Texas fever, surra, fungus and nematode diseases, etc., as well as many other titles that are even more remotely connected with the subject of bacteriology, but particular attention at this time is desired to a single feature.

One at all acquainted with the literature of the subject is at once struck by the paucity of reference to articles published in the United States. A careful examination of the contents of the volume revealed but about eighty titles of books, addresses, magazine articles, etc., nineteen different periodicals being represented in the list. The *Journal of the Boston Society of Medical Sciences* is first in the list with fifteen references, followed by *Popular Science Monthly* with nine, the *Journal of the American Medical Association* with six, and the *Philadelphia Medical Journal* with the same number, the others having from four to a single title indexed. None of the publications of the U. S. Department of Agriculture nor of any of the Experiment Stations are mentioned, although during 1901 there were published from these institutions many articles relating to the bacteriology of plant diseases, dairying and veterinary science. For the sake of confirming the catalogue references a number of publications of 1901 were examined to see if they were prop-

erly represented. The *Journal of Comparative Medicine and Veterinary Archives* is mentioned but once in the catalogue, although there were eighteen leading articles in which bacteria were described as the cause of the disease mentioned, and in some cases extensive studies were given of the diagnostic and cultural characters of the organisms. In the *American Veterinary Review*, not noticed in the catalogue, there appeared sixteen original articles similar to the above. In the *Medical Dial*, also not noticed, were nine leading articles treating of bacteriological studies, diagnoses and bacterial investigations of water supplies, milk, etc. The *Medical Record*, to which there appear five references for the whole year, contained in the issues from June to December, twenty-two articles that one would have expected to have found mentioned.

Since this publication, having an American representative, shows such an inadequate representation of American literature, it can hardly be wondered that so many European investigators not having access to the original publications are unacquainted with what is done on this side. Omissions from the present volume are to be included in the next, according to a note in the catalogue, and it is to be sincerely hoped that a greater effort will be made to fairly represent our American scientific literature.

Walter H. Evans.

Washington, D. C.

BOURNE'S COMPARATIVE ANATOMY OF ANIMALS.*

The first volume of the two comprising this work has already been noticed in this journal (Science, Vol. XII., p. 311, 1900). The present volume consists of a series of somewhat detailed descriptions of the structure and ontogeny of selected types of animals, the whole being intended to fit students for the preliminary and intermediate examinations in the British universities. The animals selected are the liverfluke (how this is cœlomate does not appear), earthworm, fresh-water mussel, snail, *Apus, Astacus*, cockroach, *Amphioxus*, dogfish, frog, with a chapter on other annelids and a final one on the mammals.

As a whole, the descriptions are clear and accurate, and the seventy-seven illustrations illustrative of the text. Particularly instructive is the cut (fig. 44) of the pharyngeal region of *Amphioxus*. However, it is not well adapted for use in American schools, for it tells the student just those points which we insist that he shall ascertain for himself, so far as possible, from the specimen. As a 'cram manual' it would have a value. Lastly, the title is misleading. The whole work is descriptive, not comparative; in fact comparisons and broader features are rare in this second part, which in many respects falls short of the first volume.

J. S. Kingsley.

* 'An Introduction to the Study of the Comparative Anatomy of Animals,' by Gilbert C. Bourne. Vol. II., 'The Cœlomate Metazoa.' London, George Bell and Sons, 1902, pp. xv + 321. 4*s*. 6*d*.

SCIENTIFIC JOURNALS AND ARTICLES.

The March number (Volume 9, No. 6) of the *Bulletin* of the American Mathematical Society contains: Report of the ninth annual meeting of the American Mathematical Society, by Professor F. N. Cole; Report of the December meeting of the San Francisco Section, by Professor G. A. Miller; 'The abstract group G simply isomorphic with the alternating group on six letters,' by Professor L. E. Dickson; 'Note on a property of the conic sections,' by Professor H. F. Blichfeldt; 'The analytic theory of displacements,' by Mr. R. W. H. T. Hudson; Notes; New publications. The April number of the *Bulletin* contains: Report of the January meeting of the Chicago section, by Professor T. F. Holgate; 'Some groups in logic,' by Professor E. W. Davis; 'Cesàro's Intrinsic Geometry,' by Dr. Virgil Snyder; 'Gauss's Collected Works,' by Professor James Pierpont; 'Analytic projective geometry,' by Dr. E. B. Wilson; Shorter notices; Notes; New publications.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 562d meeting was held January 31, 1903.

Professor A. N. Skinner, of the Naval Observatory, spoke by invitation on the 'Prog-

ress of the Zone Observations of the Astronomische Gesellschaft.'

All determinations of the positions of the fixed stars through the time of Hevelius (1650) were made without the use of the telescope. The time of Flamsteed (1725) marks the first use of the telescope for this purpose. Bradley's star-place determinations (1750) are considered to be the beginning of the astronomy of precision. Among the astronomers who led in the determination of star places were: Lalande at Paris, 50,000 star places (1800); Piazzo at Palermo, 6,700 star places (1800); Rümker at Hamburg, 70,000 star places (1835); Lamont at Munich, 33,000 star places (1845).

At the suggestion of Bessel the Berlin Academy of Sciences (1825) undertook the publication of star charts to contain all stars visible with a 3-inch telescope to be executed by different observers and to cover the belt —15° to +15° of declination. To furnish a groundwork for these charts Bessel swept over this area —15° to +15° decl. in zones with a meridian instrument, and determined the places of a large number of stars for 1825. Later he extended his zones from +15° to +45° decl., embracing a total of 70,000 star places between —15° and +45° decl. Argelander, a pupil of Bessel, extended Bessel's zone determinations from +45° to +80° decl. at Bonn (1842) with 22,000 star places, and southward from —15° to —31° decl., also at Bonn (1850), with 17,000 star places.

Bessel expected that only a few years' time would be required to complete the Berlin Academy charts, but their execution dragged along until 1860, when at last they were finished.

Because the Berlin Academy charts, then incomplete, proved inadequate to satisfy the increasing needs of astronomy, Argelander, with his assistants at Bonn, in 1852 commenced the 'Great Bonner Sternverzeichniss' to give the approximate places of all stars visible with a 3-inch telescope from —2° to +90° declination, accompanied by an atlas of all the stars. This great work, comprising 324,198 stars in three quarto volumes with the atlas, was finished in 1860. In 1886 Argelander's successor at Bonn, Schönfeld, extended this great catalogue from —2° to —23° declination in a quarto volume containing 133,659 stars.

The Astronomische Gesellschaft, founded in 1865, planned the first division of their great zone catalogue to comprise accurate determinations of the places of all the stars to the 9.0 magnitude, inclusive, contained in the 'Bonner Sternverzeichniss' from —2° to +80° declination, the work to be distributed among different observatories in zones of about five degrees broad. The following observatories participated in this work: Kasan, Dorpat, Christiania, Helsingfors, Cambridge (U. S.), Bonn, Lund, Leiden, Cambridge (England), Berlin, Leipzig, Albany (U. S.), Nikolajew. This series of catalogues in fifteen volumes has been published except the Dorpat zone. These fifteen catalogues will contain about 137,000 star places for the epoch 1875.0.

Immediately on the appearance of the southern extension of the Bonner Sternverzeichniss' by Schönfeld in 1886, the Astronomische Gesellschaft arranged for the determination of all the stars to the 9.0 magnitude, inclusive, in Schönfeld from —2° to —23° declination. The following observatories agreed to participate in this work: Strassburg, —2° to —6° declination; Wein-Ottakring, —6° to —10°; Cambridge (U. S.), —10° to —14°; the Naval Observatory, Washington, D. C., —14° to —18°; Algiers, —18° to —23°.

Wein-Ottakring has published the journal of its zone observations —6° to —10°; the Naval Observatory has published the journal for the zone —14° to —18° as Volume II. of its publications, second series, 525 pages quarto. The discussion of the results and the preparation of the catalogue from the Washington observations are in progress.

Mr. R. A. Harris then pointed out 'The Uses of a Drawing Board and Scales in Trigonometry and Navigation.' The object is to solve graphically spherical triangles. The apparatus consists of a board about 40 x 20 inches, with angular graduations on three sides radiating from the center of one long side, and of edge scales graduated to give

various functions of an angle or of half the angle, together with the usual T-square and straight edge. By these instruments a plane triangle is constructed having sides and angles proportional to the proper trigonometrical functions of three known parts of the spherical triangle to be solved; then the remaining parts may be scaled off.

The next paper was a report by Mr. F. G. Radelfinger 'On the Analytic Representation of Function.'

The general problem of obtaining an analytic development coextensive with the domain of existence of a function was stated by way of introduction; then the author reviewed the most important recent researches bearing on this general problem. He confined himself in the main to a synopsis of the results obtained by Mittag-Leffler in his four 'notes,' which have appeared at intervals during the last three years in his journal, the *Acta Mathematica*.

The analytic developments constructed by Mittag-Leffler are in the form of series n times infinite, which can be transformed into singly infinite series of rational polynomials; these developments converge within an extended region, which for $n = \infty$ coincides with a star introduced by him; the star embraces the whole plane excepting radial cross-cuts extending from each singular point to infinity. Several methods of constructing these expressions have been made use of and expounded in the several notes. Borel's work was also reviewed, and the extension thereof by Mittag-Leffler.

The next paper was 'On the Foundations of Geometry and on Possible Systems of Geometry,' by Dr. Henry Freeman Stecker, of Cornell University. In the absence of Dr. Stecker his paper was presented by Mr. Radelfinger.

After an introduction on the assumptions which must be made in constructing a geometry, Dr. Stecker reviewed the criticisms of Moore and Schur of Hilbert's classic paper of 1899, recently translated, and announced the concluson that in spite of all criticisms and attempted improvements, Hilbert's system has 'withstood all attacks, and remains not only apparently sound in logic, but the simplest of such systems as have thus far been constructed.'

An account was next given of Hilbert's second, and recent, great memoir, *Mathematische Annalen*, Bd. 56, which has for its object to establish Lie's well-known and indispensable results, without the assumption, made by Lie, that the functions defining the displacements are differentiable. In solving the problem Hilbert makes use of Cantor's theory of point-assemblages and Jordan's theory of a closed curve free from double points. Hilbert's results, so far as they go, establish the independence of Lie's results of the assumption stated above, but they have yet to be extended to elliptic geometry and also to space.

In conclusion a thesis by Hamel, a pupil of Hilbert's was discussed, which leads to the conclusion that 'from the standpoint of the calculus of variations the Euclidean geometry is the simplest possible.'

CHARLES K. WEAD,
Secretary.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

THE regular meeting of the section was held February 23, in conjunction with the New York branch of the American Psychological Association, Professor Thorndike presiding. Afternoon and evening sessions were held, the members dining together at the close of the afternoon session. The following papers were presented:

'Phonetic Surveys,' Professor E. W. Scripture. After brief mention of the phonetic surveys being carried on by Grierson in India and Guilleron in France, a description was given of the chief talking machine methods that may be used for this purpose. It was pointed out that the advances in the construction of phonographs, graphophones and gramophones during the last couple of years have been so great as to revolutionize these methods. It was also explained that making a speech record was like taking a photograph; everybody can take a picture, but a good picture requires skill. By use of the grapho-

phone the records made on wax cylinders can be used for making metal molds; from these indestructible molds copies in hard wax can be made. The gramophone method likewise furnishes metal molds from which hard discs are produced; but the talking machine requires an expert. This gramophone method was lately used on three expeditions sent out by the Vienna Academy of Sciences. The new methods furnish records that are perfect in recording every detail of the voice. There is not the slightest loss even of the most difficult consonants. Criticisms stating the contrary are derived from acquaintance with methods that are now out of date. From the gramophone records the curve of speech can be traced off with great accuracy; whereby every detail of the voice can be measured. A similar method can be applied to phonograph records. It was urged that the fast disappearing dialects and languages should be recorded and preserved in one of these ways. It was pointed out that such records could be made and delivered at smaller cost per word than in the case of Guilleron's 'Atlas.' It was stated that the various talking machine companies have shown self-sacrificing interest in such work, and that the Victor Talking Machine Company would be willing to loan its record-taking car when it is finished. Exhibits of various material and speech curves were made.

'Correlations of Measurements of Growth,' Dr. Clark Wissler. (Read by title.)

'Correlations in School Children,' Dr. J. H. Bair. The measurements were taken on Worcester school children. A high coefficient of correlation was shown between stature and height-sitting, stature and weight, and height-sitting and weight. Between stature, height-sitting, weight, with length of head and width of head the amount of correlation was much less and much more irregular than between the measurements first named. This irregularity was partly due to the small number of cases examined.

'Apparent Motion in Stereoscopic Vision,' Professor J. E. Lough. Stereoscopic pictures may be united without the aid of a stereoscope, *i. e.*, by direct fixation, whenever the distances between similar objects in the two pictures is not greater than the interocular distance. When pictures are so united—giving a direct perception of the third dimension—any movement of the picture from side to side gives the impression that objects in the background are moving through a greater distance than are the objects in the foreground. This 'slipping' of the background is perceived with still greater vividness when the picture remains stationary and the head is rotated or moved from side to side. In bringing a stereoscopic picture nearer the eyes the background seems to approach more rapidly than the foreground, and in moving the picture away from the eyes the background seems to move away more rapidly. The apparent motion in stereoscopic pictures seen under the above conditions is probably due to the fact that the angle of parallax remains constant, while the line of direction varies, with every movement of the head or of the picture.

'An Experiment in Facial Vision,' Professor Robert MacDougall. The paper supplements and in three respects aims to correct the reports of previous experiments on facial vision. In the perception of objects in proximity to the face independently of the sense of sight, the nature of the sensory impression upon which perception depends is not commonly discriminated. In the present investigation the percentage of correct perceptions was found to lie between 50 and 75, that is, within the subliminal region. This result is contrary to previous work in which the percentage lay clearly above the threshold of 75. If a true perceptual process be involved, the percentage of correct responses should be a function of the absolute differences between the objects discriminated. This was found to be the case in the present set of experiments, but not in preceding investigations. In work published heretofore the perception was reported to be mediated solely by sensations of sound; but in the present investigation the shutting off of auditory stimulation made practically no reduction in the percentage of correct responses.

'Notes on the Washington Meeting,' Professor E. H. Sneath. The Washington meeting, if compared with a possible meeting of psychologists twenty-five years ago, shows the lines along which progress has been made. Such a comparison demonstrates clearly (1) the special training required of the psychologists of to-day; (2) the position of psychology among the sciences; (3) the growth of productive scholarship; (4) the differentiation of the work into experimental, genetic, comparative, abnormal, educational, etc.; (5) the development of new methods of approach.

'Grades for Mental Traits,' Professor J. McKeen Cattell. This paper treated the accuracy with which grades can be assigned for college studies, and the methods to be employed in assigning grades. Those who do well in one study or have one trait in excess are likely to do well in other studies and to have other traits in excess, and they are more likely to succeed in after life. It was shown, however, that the grades assigned to students have not very great validity. It was recommended that grades be assigned in a scale of ten and that a probable error be attached to the grade. The grades should represent groups of equal size rather than equal differences in merit. The paper also discussed the grade assigned to large groups for mental, moral and physical traits, and gave some of the results that the writer had obtained.

'A Preliminary Report on Tests of One Hundred Men of Science,' W. H. Davis. (Read by title.)

James E. Lough,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

At the regular meeting of the Texas Academy of Science held in the chemical lecture room of the University of Texas on Friday evening, November 28, 1902, the following papers were presented by title:

'Contribution to a Knowledge of the Coleopterous Fauna of the Lower Rio Grande Valley in Texas and Tamaulipas, with Biological Notes and Special Reference to Geographical Distribution,' by C. H. T. Townsend, El Paso.

'Poisonous Snakes of Texas,' by J. D. Mitchell, Victoria.

Mr. E. C. H. Bantel, instructor in engineering, University of Texas, gave an illustrated lecture on 'Iron Smelting.'

At the formal meeting held in the university auditorium on Monday evening, December 29, 1902, Dr. William L. Bray, professor of botany, delivered an illustrated lecture on 'The Evolution of the Flower and its Relations to Insects and other Pollenizing Agents.'

The following papers appeared by title on the program of this meeting:

'The Effect of Weeds and Moss upon the Coefficients of Discharge in Small Irrigating Canals,' by J. C. Nagle, professor of civil engineering in the Agricultural and Mechanical College of Texas, College Station.

'The Decomposition of Potassium Chlorate at Fixed Temperatures,' by Eugene P. Schoch, Ph.D., and J. S. Brown, B.S.

'The Kinetics of Oxidation Reactions. Example I. The Equilibrium between Potassium Ferrocyanide, Potassium Ferricyanide, Iodine and Potassium Iodide,' by Eugene P. Schoch, Ph.D., instructor in chemistry, University of Texas.

'Contribution to the Chemistry of Fatigue,' by Dr. Henry Winston Harper, professor of chemistry in the University of Texas, and Margaret Holliday, M.S.

At the regular meeting held in the zoological lecture room of the university, on Saturday evening, March 14, 1903, the following papers were presented, both of which were illustrated with stereopticon views:

'Some Wholesome Educational Statistics,' by W. S. Sutton, M.A., professor of the science and art of education in the university.

'Steel Making,' by E. C. H. Bantel, C.E., instructor in engineering.

Frederic W. Simonds,
Secretary.

CLEMSON COLLEGE SCIENCE CLUB.

At the regular monthly meeting of the club on Friday evening, February 27, Professor J. V. Lewis presented an illustrated paper on 'The Occurrence and Origin of Corundum in the Eastern United States.'

Corundum occurs in the crystalline rocks of the Appalachian region in granite, gneiss, mica-schist, crystalline limestone, etc., but thus far the only deposits that have been profitably exploited occur in basic magnesian rocks, chiefly peridotites, with smaller bodies of pyroxenites and amphibolites. The sapphire or gem variety, common corundum, and emery have all been found in this region. The second occurs most commonly with the peridotites, and, except in one or two localities, is much the most important. It occurs at intervals from Alabama to Massachusetts, and has been mined in Pennsylvania, North Carolina and Georgia, occurring chiefly in vein-like zones about the borders of the peridotites and sometimes penetrating the mass of these rocks.

North of North Carolina the peridotites are extensively altered into serpentine, steatite, etc. In North Carolina and southward they are chiefly unaltered. The studies of Lewis and Pratt have demonstrated (1) that the peridotites are igneous intrusives, and (2) that the corundum has most probably been formed by segregation from a state of solution in the molten magma. These results have been briefly presented in a report shortly to be published by the North Carolina Geological Survey.

In the discussion of this paper, Dr. P. H. Mell stated that he had had occasion to investigate these peridotites and corundum deposits in the seventies, when they were first beginning to attract attention. He collected material from which, to the best of his knowledge, the first corundum wheel ever made had been manufactured. He traversed the whole region, from Alabama to Massachusetts, and arrived at the conclusion that both the corundum and the peridotites are of igneous origin, which view was almost unanimously rejected by geologists at the time. Therefore, he was very much gratified to find that the results of the latest investigations of these rocks confirmed his own conclusion.

CHAS. E. CHAMBLISS,
Secretary.

A. AND M. COLLEGE OF SOUTH CAROLINA,
CLEMSON COLLEGE, S. C.

VERMONT BOTANICAL CLUB.

THE eighth annual winter meeting of the Vermont Botanical Club was held at the University of Vermont on January 16 and 17. The officers were reelected for the ensuing year as follows:

President—Ezra Brainerd, Middlebury College.
Vice-President—C. G. Pringle, University of Vermont.
Secretary—L. R. Jones, University of Vermont.

It was the sentiment that the summer field meeting, about July 1, be held on Stratton Mountain.

The following program was presented:

CLIFTON D. HOWE: Annual Address—'Some Results of Deforestation in Vermont.'

PRESIDENT EZRA BRAINERD: 'Vermont Violets.'

WILLIAM H. BLANCHARD: 'More Finds in My Section.'

MISS ALICE E. BACON: 'An Experiment with the Fruit of the Red Baneberry.'

MRS. FREDERICK A. RICHARDSON: 'Reversion in a Columbine.'

MISS ELIZABETH BILLINGS: 'A Many Branched Spleenwort.'

WILLIAM STUART: 'Nitrogen Gatherers.'

MRS. H. E. STRAW: 'Ferns of Smugglers and Nebraska Notches.'

H. M. SEELEY: 'My Aster.'

MRS. E. B. DAVENPORT: 'Recollections of Mr. C. C. Frost.'

L. R. JONES: 'The Frost Herbarium.'

JOHN HENLEY BARNHARDT: 'A List of Vermont Local Floras.'

E. A. BURT: 'The Thelephoræ of Vermont.'

MRS. NELLIE F. FLYNN: 'Additions to the Flora of Burlington and Vicinity during 1902.'

G. T. MOORE: 'The Pollution of Water Supplies by Algæ.'

MISS RUTH B. FISHER: 'An Appeal for More Study of the Lower Plants in our Schools.'

PRESIDENT EZRA BRAINERD: 'The Chandler Herbarium.'

W. W. EGGLESTON: 'A Canoe Trip in Northern Maine.'

CARLTON D. HOWE: 'Plant Progression.'

F. A. ROSS: 'Vagaries of *Hepatica*.'

MISS M. EVA BAKER: 'The Message of the Trees.'

L. R. JONES,
Secretary.

NEBRASKA ORNITHOLOGISTS' UNION.

The fourth annual meeting of the Nebraska Ornithologists' Union was held in Lincoln, Neb., January 24, 1903, on which occasion the following papers were read:

Rev. J. M. Bates: President's address—'Birds and Man.'

Mrs. C. S. Lobingier: 'Educational Value of Bird Study.'

Miss Anna Caldwell: 'Devices for Interesting Children in Bird Study.'

Rev. J. M. Bates: 'Observations on the Number of Birds to the Square Mile in Custer County.'

Mr. Wilson Tout: 'The Crow in Nebraska.'

Mr. Myron Swenk: 'The Birds of the Niobrara Valley.'

Dr. R. H. Wolcott: 'Birds of Cherry County, Neb.

Dr. R. H. Wolcott: 'Remarks on a Record of Nebraska Ornithology.'

Newly elected members raised the total membership of the society to nearly two hundred.

The following officers were elected:

President—F. H. Shoemaker, Omaha.

Vice-President—Miss Anna Caldwell, Lincoln.

Corresponding Secretary—J. C. Crawford, Jr., West Point.

Recording Secretary and Editor (permanent)—Dr. R. H. Wolcott, University of Nebraska.

Treasurer—Mr. August Eiche, Lincoln.

Executive Committee—Dr. G. E. Condra, University of Nebraska; Dr. H. B. Lowry, Lincoln; J. A. Dickinson, Gresham.

The office of Custodian was created as a permanent office and Myron Swenk, of Lincoln, appointed to fill it.

The presentation of a considerable amount of material, including many skins on which records are based, was reported, and it was resolved to secure, if possible, for the collection, all the material in the state upon which the past records of the occurrence of rare birds in Nebraska had been based.

A committee was appointed to complete the formal organization of the Audubon Auxiliary and to put in definite shape terms of affiliation between it and the union.

Robert H. Wolcott,
Secretary.

DISCUSSION AND CORRESPONDENCE.

BIOMETRY AND BIOMETRIKA.

To the Editor of Science: May I as one of the editors of the above journal make a personal appeal to the American scientific world through your columns? My reasons for doing so are twofold. In America the novel, be it in science, politics or industry, is not *a priori* condemned as the undesirable or the fatuous, which is its customary fate in Europe. Secondly, the list of American subscribers to our journal shows us that American biologists and mathematicians are willing to consider on its own merits what biometry has to say for itself; they are not from the beginning hostile to the new movement. In Europe the older teachers will have nothing to do with the subject. The list of subscribers shows that we depend chiefly upon the younger workers here; and every difficulty is put in the way of their doing biometric work. This is extremely serious, for it means that appointments and fellowships will not follow on research work in biometry, and thus young scientists are and will be discouraged from taking it up. Quite recently a young American biometrician working here was surprised to find the scorn with which the officials at a great national institution treated his measuring work. 'Well, tell us what biometry has proved?' was the question put to him by officials, whose library contained no copy of the journal, and who apparently had never studied its pages. Another young worker proceeding to take up a colonial appointment was warned by one of the doyens of zoology on all grounds to give up this foolish biometric work. A third, going to work in one of the greatest continental zoological laboratories, finds its world-renowned head disgusted because he attempts to solve a problem by statistics which in fact can and can only be solved in that way.

None of our responsible biometricians claim that there is *one* way only of solving *all* biological problems, but solely that there is only one way, the statistico-mathematical method, in which *certain* problems can be answered. We do not, therefore, aim at depriving biologists, pure and simple, of their field of ac-

tivity. We do not call upon them all to return to school and learn mathematics. What we do say is that, in a certain part of that field, their past conclusions have been based on inadequate reasoning, and we place at the disposal of those who are willing or able to use it a new instrument of investigation. For the many who have not a taste for statistics or mathematics, we have endeavored to provide with each number of our journal a brief summary of what our contributors consider their investigations to demonstrate. A brief examination of these summaries will show the unprejudiced that, on the one hand, no attempt has been made to exaggerate the value of the work done, nor, on the other, has biometry failed to achieve something in the first year during which it has possessed an organ of its own. In the case of the mathematician we have even more to offer than to the biologist; we ask him to see that his science has far wider applications than he has hitherto dreamt of; that a door has been opened to him which quite doubles the space to which he has so far had to confine himself. That in future he may revel in vital phenomena as he has hitherto revelled in the physical universe. That perfect correlation, the causal nexus of the physicist, is only a special case of the general theory of correlation which covers organic as well as inorganic relationships. The older mathematicians worked only under the category of causation, the moderns can also work under that of correlation. In the light of our present knowledge the chapters in treatises on scientific method, which center round 'causation' as the fundamental idea, seem as inadequate as the formal logic of the schools is when compared with 'the numerically definite syllogism.' The mathematician who sees causation as merely a special case of correlation passes—to use a not entirely fanciful geometrical analogy—from space of two to space of three dimensions. Anthropology, craniology, psychology and child study and pedagogy, as well as biology, become fields of work crowded with new problems for the mathematician to tackle; nor must the workers in those fields look upon him as an 'undesirable alien.' He comes to enrich their own domestic industries with new processes and show them how to handle new and powerful instruments of research. There are signs—very hopeful signs—that this broader view of cooperative action is beginning to be realized in America; it will take a generation or two to produce much effect upon the conservative minds of European scientists, who, circumscribed by an over narrow specialization in field and method, are only annoyed if one suggests that for certain tasks the steam plough is more effective than the spade. In England this great reluctance to adopt new ideas is as manifest in science as in commerce and national defence; it is leaving our race behind in both education and industry.

My appeal accordingly to the American scientific world would be of a double nature. Our journal must perforce have an uphill struggle for the first few years of its existence; we are determined to see it successfully through that struggle, but this task can be made a good deal easier for us by both material and intellectual sympathy from your side of the Atlantic. There are many growing public and academic libraries in America; we feel convinced that they will need *Biometrika* ten or fifteen years hence. They will make our task lighter if they aid now by subscribing in our infancy. I would make a like appeal to both biologists and mathematicians; we want additional subscribers, and we want to be studied and read, and not condemned *a priori* without examination. In the next place, the Carnegie Trust gives America a splendid opportunity to judiciously foster new phases of scientific work. I would appeal to those who have to manage that trust not to put hindrances in the way of young men or women who may be seeking to do biometric work. Such persons have got to combine two or three usually separated faculties; they must be moderate mathematicians, intelligent biologists and observant field naturalists. Do not subject them to a severe triple test, or demand that they shall be at the summit of the tree in mathematics and in laboratory work and in field observation. The engineer must know some mathematics, some

physics and some geology; but we don't expect him to be a first-class proficient in all three sciences. We judge him finally as an engineer. So it must be in biometry. No one can get on without some mathematics, some biology and some field work in this new science; but its workers must be ultimately judged as *biometricians*, and not as mathematicians or biologists. Don't allow, however great their reputation or authority, the pure mathematician or the descriptive biologist, who may never have done a stroke of biometric work, to override biometric workers' claims to recognition. Remember that we have here a new branch of science, which has its own methods and its own disciples. Like all young things, it has its future before it, and no amount of step-motherly treatment will, in the long run, profit the reputation of the scientific community which practices it. In the matter of biometry, America has not yet adopted a hostile attitude. I write in the hope that it may never do so.

Karl Pearson.

University College, London, England.

THE DESTRUCTION OF FROGS.

Apropos to the note of Mr. Albert M. Reese, relative to the destruction of frogs, I will say that I once witnessed the same thing in Columbus, Ohio, along the Neil Avenue Street Railway. It was in spring, and the frogs had evidently migrated from the Olentangy River, a short distance away and running parallel with the avenue. I did not count them, but there were very many that had been crushed under the car wheels within a distance of perhaps one fourth of a mile. As I recall, the frogs were crushed across the middle. My observations were made in the morning and I inferred that the migration had taken place either in evening or early morning.

H. A. Weber.

A RARE SCIENTIFIC BOOK.

To the Editor of Science: There is a copy of Purkinje's 'Commentatio de examine physiologico,' etc. (concerning which Professor Wilder inquires in the issue of Science for April 3) in the Library of the Surgeon General of the War Department at Washington.

F. W. Hodge.

Washington, D. C.,
April 4, 1903.

THE IMPROVEMENT OF THE MEETINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

To the Editor of Science: The changes in the arrangements for the meetings of the American Association, proposed by Professor Davis in Science, pages 428–430, and of which I heartily approve, lead me to make the following suggestion that can be carried out easily by the secretaries of the sections.

At the entrance to each sectional meeting-place, let a doorkeeper write upon a blackboard the paper then being read or discussed, and also the paper that will be called next. It is usually impossible for a section to follow the daily program, as printed, or even to restrict the papers to the time allotted to each; therefore, the expedient suggested will obviate the embarrassment to the speaker, as well as the distraction of his audience, caused by the frequent entrance and exit of persons who merely desire to ascertain what paper is being read, and, by showing this at a glance, it will aid such people as wish to hear certain papers in several sections meeting simultaneously.

These bulletins of the current communications are commonly employed at the meetings of the British Association for the Advancement of Science, where they are regarded as so useful that there has been general complaint whenever they have been inadvertently omitted. If tried at the St. Louis meeting of the American Association, I am convinced that we also shall adopt this custom permanently.

A. Lawrence Rotch.

Blue Hill Observatory,
March 18, 1903.

SHORTER ARTICLES.

THE OCCURRENCE OF THREE INTERESTING FISHES ON THE NEW JERSEY COAST.

MANTIDÆ.

1. Manta manatia (Schneider).

1792. *Raja, birostris, rostro bifido* Walbaum, Pet. Arted. Gen. Pisc., III., p. 535 (based

on Zee duiivel, Diabolus marinus Willughby, Hist. Pisc., App., 1686, p. 5, plate 9, fig. 3; no locality; pre-linnæan). [Nonbinomial.]

1801. (*Raja.*) *Manatia* Schneider, Syst. Ichth., p. 364 (based on La Raie Manatia, Lacépède, Hist. Nat. Poiss., I., 1798, p. 160; les rivages de l'Amérique voisins de l'equateur; nonbinomial).

1824. *C.(ephalopterus) Vampyrus* Mitchell, Ann. Lyc. Nat. Hist. New York, I., p. 23, plate 2, fig. 1; "near the entrance of Delaware bay, by the crew of a smack. They had heard that creatures of extraordinary form and size, were frequent in the tract situated off Capes May and Henlopen, during the warm season."

1824. *C.(ephaloptera) gigantea* Le Sueur Journ. Acad. Nat. Sci. Phila., IV., p. 115, plate 6, figs. 1–4; taken near the entrance of the Delaware (Coll. Philadelphia Museum).

A large example of this species was taken in the sea, about a mile from shore, at Stone Harbor, N. J., September 1, 1902. It was taken in a pound net with the harpoon by some fishermen, and then dragged ashore behind a whaleboat. When in the net it behaved very quietly until harpooned, after which it created a great disturbance. It soon died, however, when brought on the beach. Nothing was preserved except one of the eyes and a small piece of the skin. The former measures about two and one eighth inches in diameter, and its pupil about eleven sixteenths of an inch. These are contained in the collections of the Academy.

As Walbaum is nonbinomial, the next available name is that proposed by Schneider. The name in current use, *Manta birostris,* will thus be superseded by *Manta manatia.*

SCOMBRIDÆ.

2. THUNNIS THYNNUS (Linnæus).

1758. (*Scomber.*) *Thynnus* Linnæus, Syst. Nat., Ed. X., p. 297; inter Tropicos, in Pelago (based on *Scomber pinnulis,* etc., Artedi, Ichth., 1738, p. 31; no locality, evidently the great tunny of Europe).

I examined a large example, a little over eight feet in length, which was said to have weighed 700 pounds. It was brought to the Philadelphia market November 4, 1898, from near Brighton, N. J., where it was taken in the ocean. No attempt was made to use the flesh, and it remained on exhibition for several days.

CEPHALACANTHIDÆ.

3. CEPHALACANTHUS VOLITANS (Linnæus).

1758. (*Trigla.*) *volitans* Linnæus, Syst. Nat. Ed. X., p. 302; in Mari Mediterraneo, Oceano, Pelago inter tropicos, in Asia, imprimis ad Cap. b. spei, sape agitata evolans ex aqua (part; based in *Trigla capite,* etc., Artedi, Ichth., 1738, p. 44; mare Mediterraneum).

A large example of this species was taken at Holly Beach, October 11, 1902. It is now in the collection of the Academy of Natural Sciences of Philadelphia.

HENRY W. FOWLER.
ACADEMY OF NATURAL SCIENCES,
PHILADELPHIA, PA., January 17, 1903.

CURRENT NOTES ON METEOROLOGY.

BIGELOW'S BAROMETRY.

VOLUME II. of the 'Report of the Chief of the Weather Bureau for 1900–1901' is an elaborate 'Report on the Barometry of the United States, Canada and the West Indies,' prepared by Professor F. H. Bigelow. The volume numbers 1,005 quarto pages, and contains 55 tables and 39 charts. The need of some revision of the barometric observations becomes apparent when it is recalled that these observations have not hitherto been reduced to a homogeneous system by the application of all the necessary reductions. The method of reduction has also varied from time to time. Four methods of reduction have been employed before the one contained in this report. Professor Bigelow has preserved the Ferrel system of reduction, has 'added another for local abnormality, computed the effect of the vapor pressure separately from that of the free air, and discussed thoroughly the temperature argument, so that these, added to the usual free-air reduction, give the ones required for the plateau districts.' Some idea of the scope of the report may be gained

from a brief enumeration of a portion of its contents, *e. g.*, new barometric reduction tables for reductions between any two planes within the elevations from sea level to 10,000 feet; the construction of temperature gradients in latitude, longitude and altitude for all stations of the United States; the computation of the vapor tension on the sea level, the 3,500-foot and the 10,000-foot planes; the construction of charts of pressure, temperature and vapor tension for each month and the year on the three planes just mentioned; the preparation of special station tables for the practical work of reducing the observations to sea level, to the 3,500-foot plane, and the 10,000-foot plane for the daily weather maps; the compilation of tables giving the normal values of the pressures, temperatures and vapor pressures at the stations and on the three planes. The volume is one of the most important publications of the United States Weather Service since its establishment.

METEOROLOGICAL OBSERVATIONS IN BOSNIA.

IN the *Meteorologische Zeitschrift* for January, Hann discusses the observations (1895–1901) made at the observatory on Bjelasnica, a mountain 2,067 meters high in Bosnia—interesting because it is situated further to the southeast than any high-level station in Europe. The pressure, as in the case of all mountains in the Temperate Zone, rises considerably from winter to summer. The winters are abnormally cold, even as compared with the mountain stations in somewhat higher latitudes, the explanation undoubtedly being that Bjelasnica lies on the south or southeast of the winter barometric maximum over the Alps, and consequently its winds are north, northeast or east. The frequent inversions of temperature, and the bright dry days, which characterize the Alps in winter, and help so much to produce the remarkable winter climate of many of the higher Alpine stations, are conspicuous by their absence on Bjelasnica. Very remarkable frost formations are observed in winter, rivaling those of Ben Nevis and the Brocken, which have often been described and photographed. On February 20, 1902, for example, the frost needles reached a maximum length of 2.8 meters, after a growth of three days with light southerly winds; a mean temperature of 26°.6, and a mean relative humidity of 93 per cent. Several needles over three meters long broke off partly by their own weight, and partly because of the wind. To the neighborhood of the Adriatic Sea these extraordinary frost formations are due, as, in the case of the Brocken and of Ben Nevis, they are due to the proximity of the Atlantic Ocean.

HIGH WINDS ON THE PACIFIC COAST.

HIGH winds are not commonly associated with Pacific Coast meteorology. Hence an account of some high-wind records on that coast, in the Annual Report of the California *Climate and Crops,* is of interest. These records were made at the new Weather Bureau station at Point Reyes Light (lat. 38° 12′ N., long. 122° 51′ W.). On February 23–25, 1902, during a 'severe southeast disturbance' along the coast of California, velocities up to 100 miles an hour were observed. On March 1 the wind blew for a few minutes at the rate of 107 miles an hour. Between May 15 and 20, 1902, with a marked depression over the Mexican boundary and the valley of the Colorado, the maximum wind velocity was at the rate of 110 miles an hour.

R. DEC. WARD.

SCIENTIFIC POSITIONS UNDER THE GOVERNMENT.

THE civil service commission announces a number of examinations for positions in the scientific service of the government. On April 21 and 22, there will be an examination for the position of aid in the Coast and Geodetic Survey, the age limit being from 18 to 25 years, and the salary $750 and traveling expenses. There are twelve vacancies to be filled by this examination.

On May 5 there is an examination for the position of computer for nutrition investigations in the Office of Experiment Stations, at a salary ranging from $720 to $1,000.

On May 5 and 6 there is an examination for the position of field assistant in forestry at a salary of $1,000.

On May 16, there are examinations for positions in the Bureau of Plant Pathology Industry of plant physiologist, at a salary of $1,500; of plant pathologist, at a salary of $1,600; of viticulturist, at a salary of $1,600; and of physiological chemist in cereal investigations, at a salary of $1,500. Further details concerning these and similar examinations can be obtained from the U. S. Civil Service Commission, Washington, D. C.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR HERMANN STRUVE, of Königsberg, has been given the gold medal of the Royal Astronomical Society.

THE University of Halle has conferred a gold medal on Professor J. P. Pawlow, of St. Petersburg, for his research on digestion.

THE Institute of France has awarded to Dr. Emile Roux, the subdirector of the Pasteur Institute, the prize of $20,000, founded by M. Daniel Osiris, for the person that the institute considered the most worthy to be thus rewarded. It is said that Dr. Roux will give the money to the Pasteur Institute.

DR. F. SCHAUDINN, of Berlin, has been awarded the Tiedemann prize by the Senkenburg Society, at Frankfurt a. M., for his biologic studies and monograph on the Coccidia.

M. T. H. SCHLOESING, JR., has been elected a member of the Paris Academy of Sciences in the section of agriculture in the place of the late M. Dehérain.

WE noted last week the election of Dr. Robert Koch, as foreign associate of the Paris Academy of Sciences, in succession to Professor Rudolf Virchow. It may be added that Dr. Robert Koch received twenty-six votes, Dr. Alexander Agassiz eighteen votes, Dr. S. P. Langley six votes and Professor van der Waals, of Amsterdam, one vote.

PROFESSOR SOLMS-LAUBACH, of Strasburg, and Professor K. Goebel, of Munich, have been elected honorary members of the Botanical and Zoological Society of Vienna.

PROFESSOR H. A. SURFACE, of the Pennsylvania State College, has been appointed economic zoologist to the state of Pennsylvania.

DR. LEONARD P. KINNICUTT, professor of chemistry at the Worcester Polytechnic Institute, has been appointed consulting chemist to the Connecticut State Sewage Commission.

MR. E. E. EWELL has resigned the position of assistant chief of the Bureau of Chemistry, U. S. Department of Agriculture, for the purpose of accepting the position of manager of the Atlanta office of the Propaganda Department of the German Kali Works. Mr. Ewell's service in the Department of Agriculture dates from August, 1889.

PROFESSOR J. A. EWING, F.R.S., professor of mechanism and applied mechanics at Cambridge University, has been appointed director of naval education, Great Britain.

MR. T. H. HOLLAND has been appointed director of the Geological Survey of India, in succession to Mr. C. L. Griesbach, who has retired.

PROFESSOR H. H. DONALDSON, of the University of Chicago, has been elected president of the Chicago Neurological Society for 1903.

MR. ALFRED NOBLE has been elected president of the American Society of Civil Engineers.

PROFESSOR JOHN M. COULTER, head of the Department of Botany, in the University of Chicago, will be absent in Europe during the spring, summer and autumn quarters.

DR. J. MARK BALDWIN, professor of psychology at Princeton University, sailed for Europe on April 4.

DR. JOHN MARSHALL, professor of chemistry in the Medical School of the University of Pennsylvania, has been granted leave of absence and will spend the time abroad.

DR. N. L. BRITTON, director-in-chief of the New York Botanical Garden, and Mrs. Britton returned from Cuba on April 4. During the brief visit made to the island a large collection of herbarium specimens was made principally from the region around Matanzas, and some

desirable specimens were brought back for the conservatories. Valuable assistance was rendered by Mr. John Shafer, curator of the herbarium of the Carnegie Museum, Pittsburgh. In addition to the great amount of material secured which will be of great value in the continuation of investigations upon the flora of the West Indies Dr. Britton was so fortunate as to secure a number of rare botanical books not previously in the library of the garden. Mr. Percy Wilson, museum aid, returned from Honduras, March 18, bringing a large collection of living and prepared specimens of plants from the region near Puerto Sierra and Puerto Cortez.

DR. JAMES B. OVERTON, professor of biology at Illinois College, Jacksonville, Illinois, on a grant from the Carnegie Institute as research assistant, will spend the next collegiate year in study and investigation at the University of Bonn, at the special request of Professor Eduard Strasburger, the director of the Botanical Institute.

R. M. STRONG, Ph.D. (Harvard, 1901), instructor in biology at Haverford College, 1902–3, has been appointed to a Carnegie research assistantship with Professor C. O. Whitman at the University of Chicago.

MR. A. D. SELBY, botanist to the Agricultural Experiment Station at Wooster, Ohio, who has been in residence at the New York Botanical Garden since December, has been granted a research scholarship of the Garden.

DR. THOMAS M. BALLIET, who for fifteen years has been the superintendent of public schools in Springfield, Mass., has recently been honored with a banquet by some one hundred and fifty of the leading men of that city. After many appreciative speeches the affair closed with the presentation to Dr. Balliet of a handsome set of the works of the late Dr. John Fiske.

LIEUTENANT KOLTSCHOK has been sent, by the St. Petersburg Academy of Sciences, to search for Baron Toll, who, last June, left the major part of his polar expedition, and with a few companions proceeded to Bennett Land.

A COMMITTEE has been formed in Paris with M. H. Moissan as chairman to strike a medal in honor of the late M. P. P. Dehérain, formerly professor of plant physiology in the University of Paris. Subscriptions should be sent to M. Pierre Masson, 120 boulevard St. Germain, Paris. Those subscribing 25 francs will receive a copy of the medal.

DR. JULIUS VICTOR CARUS, associate professor of comparative zoology at Leipzig, died on March 10, at the age of seventy-nine years.

DR. FRANZ STUDNICKA, professor of mathematics at Prague, died on February 21 at the age of sixty-seven years.

DURING the past winter geological work has been carried on by the Louisiana State Geological Survey along the following lines: (1) the stratigraphy of the oil- and water-bearing beds has been studied by Professor G. D. Harris and E. F. Lines (C. U., '04); (2) the clay and lignite deposits have been investigated by C. E. Smith, A.M. (C. U., '03); the subject of terrestrial magnetism has been in charge of Edwin Smith, detailed from the Coast and Geodetic Survey. Through cooperation with the U. S. Geological Survey, an area 1,000 miles square is now being mapped topographically about Baton Rouge. Professor Harris has been engaged for the coming summer by the Hydrographic Division of the U. S. Geological Survey to prepare, by office and field work, a monograph on the underground waters of southern Louisiana. Mr. Lines will be employed by the state to continue the collection of data in the field, looking toward the construction of large topographic models of the state for the St. Louis Exposition. Mr. Smith will soon be in the field again on economic work already begun; and later will divide his time between teaching at the State University and survey work. Mr. Joviano Pacheco (C. U.), formerly assistant on the State Survey, is now draftsman for the Southern Pacific Railroad. He will shortly be transferred to the Louisiana Survey force to aid in the construction of models for the St. Louis Exposition.

THE Civil Service Commission announces that the examination scheduled for April 21

for the position of scientific assistant has been postponed to April 28.

The Tenth Congress of Polish Physicians and Men of Science, which was to meet in Lemberg, Austria, July, 1903, has been postponed until July, 1904.

The French Association of Anatomists is this week holding at Liège its fifth meeting, under the presidency of Professor Swaen.

The American Institute of Electrical Engineers has arranged to extend certain privileges to those who are regularly pursuing studies in electrical engineering. Under proper recommendations they may be elected as students of the institute. There is a fee of $3 and the students receive the transactions and may attend the meetings.

The New York Botanical Garden announces a series of lectures to be delivered in the lecture hall of the museum building of the Garden, Bronx Park, on Saturday afternoons, at 4:30 o'clock, as follows:

April 18. 'A Tour of American Deserts,' by Dr. D. T. MacDougal.

April 25. 'The Vegetation of the Florida Keys,' by Dr. M. A. Howe.

May 2. 'The Framework of Plants,' by Dr. H. M. Richards.

May 9. 'Illustrations of Some Features of the West Indian Flora,' by Dr. N. L. Britton.

May 16. 'The Food Supply of Young Plants,' by Professor F. E. Lloyd.

May 30. 'The Color-Variations of Flowers,' C. C. Curtis.

June 6. 'The Streams, Lakes and Flowers of the Upper Delaware, and the Story of the Sundew,' by Mr. Cornelius Van Brunt.

June 13. 'Vegetable Foods,' by Dr. H. H. Rusby.

Reuter's Agency has received a letter dated from the Scottish Antarctic ship *Scotia*, at the Falkland Islands, on January 22, written by Mr. W. S. Bruce, the leader of the expedition. He says: In a few hours we take our departure for the South. Contrary to my previous intention, I am going to winter the ship if we find a suitable winter harbor, for, on account of the lateness of the season, there will not be time to set up a separate house and set the ship free. We had a most successful passage south, having accomplished the voyage in 59 days, in contrast to 92 days that we took in the Balaena in '92. We could have made a faster journey, but ran at slow speed in order to save coal and also stopped several times for coaling and for testing gear. After some preliminary accidents in handling gear, we are starting with a fairly clear field to commence good observations. We are very fully loaded down, however, with 200 tons of coal and 20 months' provisions, so we shall make as quick a passage across the Cape Horn seas as possible till we get into the smooth ice water. There we are all right and need not fear for the safety of our deck cargo. Systematic hydrometer observations and temperature observations of the surface of the sea from 30 N. have been taken, and those of the River Plate should prove of exceptional interest, since there are most remarkable and rapid changes both in density and temperature associated with strong currents. We have inspected and set up the meteorological station at Cape Pembroke, which should be as good as any in the Southern Hemisphere. This should form a very important sub-Antarctic station. We have sufficient funds to enable us to do this one year's work in the South. Now that we are on a solid basis it would be a great pity to come home before our work is really complete. A second winter, during which the ship could be kept going free, as well as the station, would be most valuable.

UNIVERSITY AND EDUCATIONAL NEWS.

Two further anonymous gifts, respectively $10,000 and $50,000, have been made to Harvard University for Emerson Hall, to be erected for the department of philosophy. The sum of $125,000 has now been subscribed toward the $150,000 required.

The Missouri state legislature in the session just closed appropriated for the State University at Columbia $75,000 for a physics laboratory and $25,000 for an addition to the chemical laboratory.

According to the financial statement of the University of Minnesota for the fiscal year ending July 31, 1902, the 23/100 mill revenue tax of the state levied annually on account of the university is producing about $150,000

per annum, which is the state's annual contribution to the funds of the Land Grant College of Minnesota. The land grant itself provides an income of about $95,000 and the income of the university itself is over $125,000. The state also makes a deficiency appropriation of $35,000. Of the total income of something less than a half million dollars, the state provides $184,000.

A fund of $10,500 has been subscribed for Harvard University to establish a lectureship in memory of Edwin L. Godkin, Harvard '71, long editor of *The Nation* and the New York *Evening Post*, who died in March, 1902. The lectures are to be on 'The Essentials of Free Government and the Duties of Citizens.'

The exercises connected with the opening of the new building of the Department of American Archeology of Phillips Academy, Andover, Mass., were held on Saturday, March 28. The address of the day was given by Frederick Ward Putnam, LL.D., of Harvard University, and about five hundred guests interested in the subject and the institution were in attendance. The foundation of a department of archeology in a preparatory school is unusual if not unique, but it is believed by the trustees that the educational value of the courses and the desirability of early training of future workers in the field both warrant the experiment.

The New Haven correspondent of the New York *Evening Post* writes: The plan of the academic faculty to exclude Greek, Latin, and mathematics from freshman year as required studies contemplates the increase of the present five required freshman studies to eight, of which five must be chosen. Modern languages are divided into French and German electives, and chemistry and history are added. It is ascertained that the corporation at its last meeting sent back the plan—after the faculty had adopted it—with a suggestion which, if accepted, would have prescribed seven freshman studies with choice of five. This modified plan would have compelled a choice of Greek, Latin, or mathematics, but the faculty has refused to accept it. At the next meeting of the corporation the matter will be voted on, and a number of that body are understood to be opposed to a change which they regard as too radical. Among its opponents are also said to be most of the classical professors. The new question is also raised, somewhat acutely, of the jurisdiction of faculty or corporation in the case.

Announcement has been made of a pre-technical course at Rochester University, graduates from which will be able to enter the junior year at the Massachusetts Institute of Technology or the College of Mechanical and Electrical Engineering at Cornell.

Further steps are being taken toward the establishment of the University of Hamburg.

There are two vacant biological fellowships in Princeton University to be conferred by appointment on graduates of not more than five years' standing in approved American colleges. Candidates may send application, with evidence of fitness, to the Registrar, Princeton University, Princeton, N. J.

Dr. Edwin H. Hughes, a Boston clergyman, has been elected president of De Pauw University.

The Boston *Transcript* announces the following new appointments at Harvard University: As instructors, H. C. Boynton in metallurgy, W. E. McClintock in highway engineering and M. A. Read in physiography. Assistants appointed for the same year are: P. R. Curtis in ore-dressing and assaying; R. C. Wells in physical chemistry, W. B. Updegraph and D. W. Howes in mechanical drawing, W. M. Gregory in paleontology and A. P. Larrabee in zoology. The following are appointed to Austin teaching fellowships: L. J. Cole, zoology; J. M. Fox in mining and metallurgy, and F. W. Russe in organic chemistry.

Professor R. E. Smith, assistant in botany at the Massachusetts Agricultural College and Experiment Station, has accepted the position of pathologist and assistant professor in botany in the University of California.

Dr. Oscar Emmerling has been promoted to an associate professorship of botany in the University of Berlin.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 17, 1903.

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MSS. intended for publication and books, etc., intended or review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

WILLIAM HARKNESS.

PROFESSOR WILLIAM HARKNESS, U.S.N., whose name has been identified with the work of the United States Naval Observatory for nearly forty years, died in Jersey City, N. J., February 28, 1903.

On his retirement for age from active service in December, 1899, he went to his home with the intention of returning to Washington, after a short rest, for the purpose of devoting his well-earned leisure to scientific work which the press of official duties had prevented him from completing. An attack of nervous prostration obliged him to defer returning to Washington until he should recover sufficient strength. Month by month he expressed his expectation soon to be strong enough to return, but he never recuperated sufficiently to carry out his cherished plans. Weakness of body confined him quite closely to the house, so much so that he dared to venture on the street not more than half a dozen

times during the last three years. The immediate cause of his death was Bright's disease, which fastened itself upon him during the last few months of his life.

The following biographical memorandum prepared by Professor Harkness' own hand gives an accurate statement in a condensed form of the facts of his education and his career. This statement is all the more interesting because the writer indicates clearly the discoveries and achievements which he deemed notable and important.

A. N. Skinner.

BIOGRAPHICAL MEMORANDUM.

Harkness (William), son of Rev. Dr. James and Jane (Weild) Harkness, born at Ecclefechan, Scotland, December 17, 1837; height, 5 feet 10.0 inches; average weight, 185 pounds; circumference of head, 23.0 inches; cephalic index, 0.733. Entered Lafayette College, Easton, Pa., in 1854, but owing to the removal of his parents to Rochester, N. Y., became a student in Rochester University in 1856, and graduated with the degree of A.B. in 1858. From Rochester he also received the degree of A.M. in 1861, and LL.D. in 1874. From Lafayette he received the honorary degree of A.M. in 1865. Studied medicine in New York, and received the degree of M.D in 1862. Was reporter in the New York Legislature for the Albany *Atlas and Argus* in 1858, and in the Pennsylvania Senate for the Harrisburg *Daily Telegraph* in 1860. Appointed from New York as aid at the United States Naval Observatory August 1, 1862. Served as surgeon at the second battle of Bull Bun, August 30, 1862. Commissioned professor of mathematics in the Navy with the relative rank of lieutenant-commander, August 24, 1863, and served at the Naval Observatory until October 4, 1865. Served with the Army during Early's attack on Washington, July 11–12, 1864. Served on the United States monitor *Monadnock* from October 17, 1865, to June 28, 1866, making exhaustive observations on the behavior of her compasses under the influence of the heavy iron armor of the ship, and also completely determining the terrestrial magnetic declination, inclination and horizontal force at all the principal ports visited during the cruise, which extended from Philadelphia to San Francisco, *viâ* the Straits of Magellan and the western passages on the coast of Patagonia. This was the most elaborate discussion of the behavior of compasses on armored ships which had been made up to that time, and all the magnetic work of the cruise was published by the Smithsonian Institution in 1871, forming a large quarto volume of 225 pages. During this cruise the *Monadnock* was present at the bombardment of Valparaiso by the Spanish fleet, March 31, 1866, and also at the bombardment of Callao by the same fleet on May 2, 1866. From San Francisco Professor Harkness traveled across the continent to Omaha, partly by military transportation and partly by stage-coach, the Pacific railroad not having been built at that time. Upon returning to Washington he was attached to the Hydrographic Office from October 14, 1866, until October 1, 1867, and to the Naval Observatory from October 1, 1867, until May 30, 1874. Observed the total solar eclipse of August 7, 1869, at Des Moines, Iowa, and there discovered the now famous coronal line K 1474. Observed the total solar eclipse of December 22, 1870, at Syracuse, Sicily, and before returning to the United States visited nearly all the principal European observatories, including Greenwich and Pulkowa. November 13, 1871, was appointed one of the original members of the United States Transit of Venus Commission, to arrange for observing the transits of Venus in 1874 and 1882.

Took part in all the deliberations of the commission, devising most of the instruments used by the observing parties, and was actively engaged for more than two years in fitting out the various United States expeditions. Attained the relative rank of commander May 31, 1872. Was attached to the United States steamer *Swatara* from June 3, 1874, to June 3, 1875, during her voyage to the southern hemisphere with the United States transit of Venus parties, and visited all the points at which she touched. His own station was at Hobart, Tasmania, and after successfully observing the transit of Venus there on December 9, 1874, he accompanied the *Swatara* to the German transit of Venus station on Auckland Island, in latitude 50° 56′ S., and to the United States station on Chatham Island, and finally left her at Melbourne, returning to Washington *viâ* the Hawaiian Islands and San Francisco, thus making a complete tour around the world. On June 22, 1875, was assigned to special duty at the Naval Observatory in connection with the reduction of the observations made by the United States transit of Venus parties. The records obtained by them consisted principally of wet collodion photographs upon glass plates, showing an image of the sun about four inches in diameter, with Venus upon it, and the problem before Professor Harkness was to devise instruments and methods for measuring these photographs which would give the relative positions of Venus and the sun with the utmost accuracy. This he accomplished in an entirely satisfactory manner, although the difficulty of the problem was so great that the most eminent astronomers of England and Germany failed to obtain any useful results from the photographs taken by their parties. While engaged upon the transit of Venus reductions, in 1877, he invented the spherometer caliper, which is probably the most accurate instrument known for determining the figure of the pivots of astronomical instruments, and in 1879 he discovered the theory of the focal curve of achromatic telescopes, which is now universally used for exactly defining their color corrections. In April and May, 1876, he set up the government astronomical exhibit at the Centennial Exposition in Philadelphia, Pa. Attained the relative rank of captain April 17, 1878. Observed the transit of Mercury of May 6, 1878, at Austin, Texas, and the total solar eclipse of July 29, 1878, at Creston, Wyoming, having charge of the United States Government parties at these places, and subsequently edited the quarto volume of 430 pages containing the reports on the eclipse, which was issued by the Naval Observatory in 1880. Immediately thereafter he took up the photographic observations of the transit of Mercury, and they were reduced under his supervision in 1880 and 1881. At the same time he also carried out some rather extensive experiments in astronomical photography, including the spectra of the sun and moon, with the view of ascertaining the most suitable kind of pyroxyline, and the best form of apparatus for photographing the corona during total solar eclipses. In 1881 to 1883 he was engaged in reducing the zones of stars observed by the late Captain James M. Gilliss, at Santiago, Chile, during the years 1849–52; but that work was suspended for want of funds on June 30, 1883, and was not completed and published until 1895. On account of the failure of the English and German astronomers to obtain any satisfactory results from their photographs of the transit of Venus of December, 1874, they decided not to employ photography in observing the transit of December, 1882, and a very prominent American astronomer urged the United States Transit of

Venus Commission to pursue the same course. To combat that idea, Professor Harkness published an elaborate paper 'On the Relative Accuracy of Different Methods of Determining the Solar Parallax,' which was immediately translated and reprinted in France, with the result that both the United States and France decided to continue the use of photography. In 1882, as the principal executive officer of the United States Transit of Venus Commission, Professor Harkness fitted out all the United States Government parties for observing the transit which occurred on December 6, of that year, and observed it himself at a station established on the grounds of the Naval Observatory, Washington, D. C. The work of reducing all the observations obtained by the various parties was assigned to him, and with the aid of a small corps of assistants he completed it in a little more than six years, the final result for the value of the solar parallax from the photographs being obtained on February 13, 1889. During the years 1889 and 1890 he devoted much time to the preparation of his work on 'The Solar Parallax and Its Related Constants,' which was published in 1891, and from that date until December, 1899, he was principally occupied with matters relating to the building of the new Naval Observatory, in devising and mounting its instruments and apparatus, and in establishing a proper system of routine observing. In 1891 he drew up the specifications for the construction of the 12-inch equatorial telescope, and for the repairing and remounting of the 26-inch equatorial telescope, the 8.5-inch transit circle, the meridian transit instrument and the prime vertical transit instrument. In 1894 he prepared detailed specifications for the construction of the 6-inch steel transit circle, and in 1895–96 he arranged all the details for the construction of the 5-inch steel alt-azimuth instrument. All these instruments are now mounted in the new Naval Observatory, and their principal parts are proportioned in accordance with general formulæ which Professor Harkness deduced from an examination of the drawings and specifications of nearly all the large instruments which have hitherto been constructed for the great observatories of the world. Among the novelties introduced in these instruments by Professor Harkness may be mentioned the dials which face the observer when using the quick motions of the equatorial telescopes, and constantly indicate the exact right ascension and declination of the points in the heavens to which these telescopes are directed, and the construction of the 6-inch transit circle and the 5-inch alt-azimuth instrument entirely of steel, including the telescope tubes and their axes, which are machined both inside and out, so as to reduce flexure to a minimum. On October 21, 1892, Professor Harkness was appointed chief astronomical assistant to the Superintendent of the Naval Observatory, and on September 21, 1894, he was appointed Astronomical Director of the Naval Observatory, with complete control of all its astronomical work. In addition to the astronomical directorship, he was appointed Director of the Nautical Almanac on June 30, 1897, and both of these offices he held until his detachment from all duty on December 15, 1899, preliminary to his retirement for age on December 17, 1899, when he was promoted to the rank of rear-admiral.

Professor Harkness has published many scientific papers, and is a member of numerous scientific societies. He was president of the Washington Philosophical Society in 1887, vice-president of the American Association for the Advancement of Science in 1881 and 1885, and its president in 1893.

APPLIED ECOLOGY.

ECOLOGY as a special branch of botanical study has been segregated from the broader field only in recent times, the name having been first suggested by Häckel some twenty-five years ago. But like many phases of human knowledge, practically the study of ecology, that is, of the adaptation of plants to their surroundings, has occupied man these hundreds of years. Long before the study of ecology assumed the dignity of a science did practitioners not only study but apply their knowledge for practical purposes in the production of plants. Agriculture and, still more so, silviculture are based upon the recognition of the ecological relations of plants.

The agriculturist goes so far as to create the ὄικος, the environment, and hence needs less knowledge of adaptation. He can create an environment desirable to any plant. But the silviculturist has not the opportunity to the same extent to fit the environment to his crop; he must study the fitting of his crop to the environment, and as his crop is required to persist for a century or so, adapted to both the stable and variable conditions of the environment, the adaptations must be studied with great care, so that the changes in environment may not prove detrimental to his crop. There are many botanists, even those devoted to ecological studies, who have not given thought to all the factors of importance in the environment which need consideration with a plant of such long duration as a tree. That trees are plants, unique in character and differently situated, as regards ecological factors, from the low vegetation, has hardly been realized.

It is in the hope of stimulating development in this direction and to enlist botanists to aid the practitioners that I venture to point out the directions in which more light is desired by the silviculturist.

Besides the general laws of ecology, which establish principles of adaptation, and which have been so satisfactorily elucidated by Schimper, Warming and others, the practitioner is especially interested in definite knowledge regarding particular species in their adaptations to particular conditions; he needs knowledge of the 'silvicultural requirements' of species, which is and has been for a hundred years his term for ecology.

There are stable or practically unchangeable factors, and unstable or variable factors of environment, with which the silviculturist has to deal.

To the stable factors he must find the crop adapted; the variable factors he can to a certain extent control and shape so as to secure satisfactory results.

The stable factors of environment are soil and general or local climate; the unstable are seasonal variations and certain climatic conditions, plant and animal associates, and light.

As regards soil, it is first of all to be considered that chemical constitution plays probably only a small part or practically none; the reliance of tree growth on mineral constituents being relatively small.

For European species a long series of analyses has shown a great variability of ash contents according to the soil on which the tree has grown, proving that a large part of these contents may be simply fortuitous and not essential to the growth. Moreover, the total amount of mineral constituents in a tree is not only very small, but by far the largest portion is found in the leaves and young parts, suggesting again their merely fortuitous presence as a residue of the transpiration current, and mostly not required. For our own species, I am not aware that any extended investigation has been made in this respect.

The physical conditions of the soil, especially with reference to water conduc-

tivity and water storage capacity, are the more important of the edaphic factors.

The most important of the adaptations to be studied here are those of the root systems, gross as well as minute.

We recognize three types, with many gradations between them—the tap-root, the heart-root and the tracing root system. It is evident that the last, shallow-rooted, system is best adapted mechanically to the shallow soils, but since it must supply itself from the surface, its chances of securing sufficient supplies are limited, hence these species are, relatively speaking, not adapted to dry soils or dry atmospheres. On the other hand, the deep-rooting species can secure water from great distances below ground. They would be naturally what the ecologist calls xerophil in their nature. This term is badly chosen, just as the term hydrophil, for the agriculturist, as well as the horticulturist and silviculturist, has amply proved that most plants love neither dry nor wet conditions, although some are more capable of enduring such extreme conditions.

The trees of the swamps, or many of them, are good examples of this adaptability, for they are also often found to occupy the driest soils. They would appear xerophil and hydrophil at the same time, but as a matter of fact they love neither and would thrive much better in such conditions as the farmer or the nurseryman prepares for his crop; it is only in the competition with other, better-adapted forms, that the unfavorable sites are left to them, to which they are still able to adapt themselves.

Some of the deep-rooters have the capacity of modifying their root system and adapting it to shallow soils. Concerning this practically so important phase of ecology we have little or no knowledge as regards our species.

The climatic range of a species in the natural field gives, of course, a first clue to its climatic adaptation, but we know now very well that mechanical barriers to progress, inefficiency in transportation, and mere competition with other forms are sufficient to exclude species from a wider field. The black locust is a most striking example, having from a very confined natural field become almost ubiquitous. Moreover, within the broader climatic range the distribution of the species is not only determined by edaphic adaptation, but by local variations of climate, such as are brought about by variable topography. Our species so far have remained largely unstudied from this point of view. Among the minor variable features of local climate it is specially the frost phenomena which are of importance, and knowledge as to what species are liable to suffer or capable of withstanding these, and under what conditions, during various periods of their life from the young seedling to the mature tree, would be most desirable.

The most important of the variable factors of environment in a forest association is the light, and the adaptability to variable light conditions of the members which make up the community is of the utmost interest to the silviculturist, and should be to the plant ecologist.

But, although the physiological relations of light to plant growth have been studied by botanists, the ecologic relations have been hardly recognized. On this field the ecologists owe an apology to the silviculturists for having failed to perceive the importance, which the latter have pointed out and appreciated for the last hundred years.

Almost the whole art of the silviculturist is based on the recognition of photic adaptations of the different species. Schimper, in his plant geography, fails even to indicate the ecologic character of this factor,

consuming the thirteen pages on which he discusses the factor of light entirely, with explanations of the physiological influence, although in passing he mentions its ecologic value as follows:

"The importance of light from the standpoint of plant geography, although in its influence upon form and life of the plant significant, is much less than that of temperature and hydrometeors; the differences in light intensity from climate to climate are insignificant in comparison with these factors. Yet, until Wiesner accentuated this influence it had usually been undervalued. The difference in intensity of light in the different climatic zones and the increasing duration of sunlight from the equator to the poles leave their impression upon the vegetation. Still more important, to be sure, is the significance of light for plant topography, since for the characterization of the single formations of a region the great differences of lighting are important."

But for any expansion on this part, namely, the topographic importance of light, we look in vain.

The relative tolerance or endurance of light among the tree species within a given climatic range is probably the most important ecologic factor which determines the character of the association. The tolerant, if adapted to climate and soil, must ultimately drive out or reduce in number the intolerant or light-needing, even though perfectly adapted to climate and soil. This accounts for the sporadic occurrence in the mixed maple-beech-hemlock-spruce forest of such light-needing species as the black cherry, the ash, the elm. It accounts for the existence of the most intolerant bald cypress or larch in the swamps, where their competitors could not follow. It accounts for the change of forest type under the influence of man, the alternation of species observed on burns and slashings.

An ecological study of the relative shade endurance of our important species is the most important need of the silviculturist.

And so we might enumerate any number of problems of practical importance for the solution of which the practitioner is waiting. And as in other sciences, which were first deduced from empirics and now direct the practice, so for ecology has come the time to direct the practice.

B. E. Fernow.
Cornell University.

WORK OF THE LICK OBSERVATORY.*

The Lick Observatory suffered an irreparable loss in the untimely death on August 12, 1900, of Dr. James Edward Keeler, director from June 1, 1898. Our appreciation of his worth has not grown dim with time. Dr. Keeler's last observations were made with the Crossley Reflector in the hope of recording the image of a ninth satellite of Saturn, reported to exist by Professor W. H. Pickering. No trace of the satellite was detected, but the plate of June 28, 1900, led to the discovery of an asteroid, 1900 GA—probably the faintest one known.

While the Observatory is preeminently an observation station, yet it is not so in a narrow sense. Success in observational work demands: (1) Knowledge of what has been done by others; (2) knowledge of pending problems, and of the most promising methods for their solution; (3) knowledge as to how observations will be used, and when they should be made, in order that they may bear most efficiently upon the problem. An institution whose efforts were confined strictly to securing observations would soon be making inferior observations. Progressive observers must be acquainted with the theories of their

* Abstract of the Director's Biennial Report, Lick Observatory, University of California, July 1, 1900, to July 1, 1902.

subjects, and must undertake occasional theoretical studies, as well as computations of considerable extent.

The hydraulic engine for turning the dome of the great telescope had been working badly for several years, limiting to an appreciable extent the productiveness of the telescope itself. It was found that the brass feed-cylinders of the engine were badly worn, permitting very considerable leakage, thereby in effect decreasing the hydraulic pressure on the pistons. The cylinders were drilled true, and new piston-heads were provided. It is gratifying to report that the dome and its entire mechanism now perform at least as satisfactorily as they did when new.

The original design of the great telescope did not provide for power to wind the driving clock; it was wound by hand. A Pelton water-wheel was installed for this purpose in 1890, but it never had sufficient power to do the work without assistance from the observer. In the past year the water power has been applied more directly to the wheel. The winding apparatus now acts immediately, without assistance from the observer.

Further to increase its efficiency, Mr. Wright has designed, and the instrument-maker has constructed, a device for turning the water power on and off automatically. This will be put in place in the near future; and it is hoped that the observer's duties in connection with the clock will be confined to starting it in the evening and stopping it in the morning.

The need of a wind screen in the opening of the dome had been felt for many years. The violent vibration of the telescope when the opening was turned toward the wind made it impossible to secure accurate observations. An effective screen was erected in 1901.

The efficiency of the thirty-six-inch equatorial was enormously increased a few years ago by illuminating the setting circles by means of electric lights operated from the eye end, thereby making it unnecessary for the observer to climb the high mounting, as he had theretofore done many times per night. Astronomer Hussey has recently equipped the twelve-inch equatorial (under his charge) in a similar manner, with good results.

Many minor improvements on the mounting of the Crossley Reflector have contributed somewhat to its stability, but the necessity for providing this instrument with a new mounting has become more apparent with time to all who have used it. Director Keeler's remarkable success was achieved at enormous expense of time and physical energy. On the average, it was necessary for him to make four or five exposures on an object before a suitable negative was secured; and in many cases he had to be satisfied with enlarged and elongated star images. His experiences have been those of Assistant Astronomer Perrine, who is now in charge of the instrument. If the mirror were provided with a suitable mounting, observers possessing their great skill should have no difficulty in obtaining three successful negatives out of four attempts. The regents in 1901 authorized the construction of a new mounting, and it is well under way.

A generation ago the astronomer ordered his telescope, and expected it to meet all his requirements. This is no longer sufficient. The wonderful developments of our science call for special instruments to do special work, and the so-called universal instrument is out of date. This is especially true in investigations along astrophysical lines. The successful instrument must have maximum efficiency in the problem to be solved. Every observatory of our class requires an instrument-making shop near at hand. This requirement is

especially pressing here, on account of our unusual isolation.

The shops at the Lick Observatory were entirely inadequate for their purpose, and I decided to utilize the first available funds for their proper equipment. The thoughtful generosity of Mrs. Hearst, regent of the university, has enabled me to complete them sooner than was expected.

The observatory early in 1901 began to publish the results of its observations in the *Lick Observatory Bulletin*. The earlier papers by members of the staff had appeared in various astronomical journals. While this plan relieved the university of expense and considerable labor, yet the vexatious delays sometimes occurring in the issue of important papers, and the appearance of the papers in so many mediums, were serious objections. The new plan has worked well. The bulletins have been supplied gratis to other observatories, to academies of sciences, and to the principal investigators.

The observatory library is growing rapidly, as far as growth by exchange of publications is concerned, but early volumes of several scientific periodicals, early volumes of observatory reports now obtainable only from second-hand dealers, and many standard books, both old and recent, are greatly needed. It is planned to supply a few of the most pressing of these needs in the near future from the funds provided by Mrs. Hearst. The library contains about 5,000 volumes and 4,800 pamphlets.

It was Director Keeler's purpose to secure with the Crossley Reflector satisfactory photographs of about one hundred of the principal nebulæ and star clusters. The portions of his program available for observation in our clear summer weather were practically complete at the time of his death, but those in position during the cloudy winter months were incomplete. We have made it a duty to carry on this work as rapidly as possible. As soon as satisfactory negatives of all the objects have been obtained, the results should be published in the best possible manner.

Visitors continue to come to Mt. Hamilton in great numbers, aggregating about five or six thousand per annum. Provision is made for explaining to them the principal features of the observatory in the day time, and for permitting them to look through the thirty-six-inch and twelve-inch equatorials on Saturday nights. In nearly all cases these privileges are appreciated. This work is useful in many ways, perhaps most of all in its resemblance to instruction along university extension lines.

The daily service of accurate time signals to the Southern Pacific Company has been continued. The signals sounding in all the offices of the system are available to the inhabitants of the regions traversed by their lines: north to Portland, east to Ogden, and south to El Paso.

The total value of gifts to the observatory in the period covered by this report has been $35,200.

Through the continued generosity of Mr. William H. Crocker, a well-equipped expedition, in charge of Acting Astronomer Perrine, accompanied by Assistant Ralph H. Curtiss, sailed from San Francisco in February, 1901, to observe the total solar eclipse of May 18, on the west coast of Sumatra. The ten instruments were duly mounted and placed in perfect adjustment. Fifteen volunteer assistants, Dutch residents in Sumatra, were trained to their duties, and the entire program of photographic exposures outlined for the expedition went through without a hitch. All went well, save that the eclipsed sun was obscured at the beginning of totality by thin clouds, which gradually thickened

during the six and one half minutes of the eclipse. Nevertheless, when the negatives were developed it was found that the observations were extremely satisfactory, valuable results having been secured with all of the ten instruments.

The photographs obtained with the forty-foot camera are admirable, the general features of the inner and middle corona being shown as well as if there had been no clouds. A most interesting and unique coronal disturbance was recorded in position angle 60°. A comparison of the solar photographs with those made on the days preceding and following the date of the eclipse by English observers in India, led to the very important conclusion that the coronal disturbance was situated immediately above the prominent and only sun-spot visible on those days.

The spectrographic and polarigraphic results were completely successful, perhaps more so than would have resulted from an unobscured eclipse. They established that the spectrum of the outer corona is identical with that of ordinary sunlight, and therefore that the light of the outer corona is not inherent, but is reflected light originating in the main body of the sun; that the spectrum of the inner corona is continuous, and therefore is not reflected sunlight; that the outer corona shows the strong polarization effects that would be expected to result from its character as reflected light; and that the inner corona gives only slight evidence of polarization, as would be expected from light largely of an inherent character.

Mr. Perrine has carefully examined the plates secured with four cameras for the purpose of detecting any possible intra-Mercurial planets. The instruments gave splendid definition, and in the unobscured areas surrounding the sun stars down to the ninth magnitude were recorded. The search was highly satisfactory for more than two thirds of the area under examination, but the clouds prevented complete success in the remaining one third. All the images on the plates were identified as those of known stars.

The discovery of the minor planet Eros in 1898, and the recognition of the unusual opportunities offered by it for an improvement in our knowledge of the distance of the sun, led to the organization of a cooperative scheme on the part of forty or fifty leading observatories, to secure the necessary observations in the fall of 1900. The Lick Observatory entered energetically upon the program outlined. Astronomer Tucker secured more than two thousand meridian circle observations of the 678 reference stars, required as a basis for the entire problem. The microscopes were read by Dr. R. T. Crawford for about 1,600 of the observations, and he rendered some assistance in the computations, but Mr. Tucker was unassisted in the bulk of the reductions. The prompt completion and publication of this extensive piece of work, long in advance of the appearance of results from other observatories, called forth many expressions of admiration for the energy and skill of the astronomer in charge.

Micrometer measures of the position of Eros were obtained by Astronomer Hussey and Assistant Astronomer Aitken, with the thirty-six-inch equatorial. The former made 832 measures in right ascension, and 896 in declination; the latter 1,650 in right ascension and 729 in declination. Photographic observations were secured with the Crossley Reflector by Assistant Astronomer Perrine, assisted by Fellow H. K. Palmer. They include 344 plates on sixty-three nights for accurate meridian places of the planet; 511 plates on thirty-seven nights for a parallax; 110 charting and connecting plates; total, 965 plates, of which 854 contain short exposures for

measurement, carrying over four thousand images of the asteroid. The measurement and reduction of these plates will be an enormous task. Fortunately, Professor Rees, director of Columbia College Observatory, has agreed to undertake that work. His efficient bureau of measurement and reduction, in immediate charge of Professor Jacoby, has already measured and reduced a number of the plates.

Perhaps the most interesting astronomical events of recent years relate to the new star in Perseus, discovered in Edinburgh on February 22, 1901. The Lick Observatory, in common with all similar institutions, made immediate plans to bring every available resource to bear upon the study of this star. Its position was measured by Mr. Tucker with the meridian circle, and by Mr. Aitken with the thirty-six-inch equatorial on several occasions in the spring and summer of 1901. It is clear from their observations, amply confirmed by those made elsewhere, that the new star is at least as far away as the faint stars surrounding it, and that its motion with reference to the surrounding stars is so slight as to elude detection for the present. The spectroscopic observations by Messrs. Campbell, Wright, Reese and Stebbins were extremely fruitful in results.

A photograph by Wolf, of Heidelberg, on August 23, 1901, had led to the discovery of masses of nebulosity in the vicinity of the new star. A photograph by Ritchey of the Yerkes Observatory on September 20 confirmed and extended the discovery, showing that the new star was apparently situated in a nebulous mass nearly circular in form, and of great extent. The photograph of this region made by Mr. Perrine with the Crossley Reflector on November 7 and 8 when compared with Ritchey's published photograph of September 20, led to the extraordinary discovery that the well-defined nuclei in the nebula were apparently in rapid motion; the magnitude of the apparent motion being at least seventy-five times as great as any sidereal motion previously known. Telegraphic announcement of this discovery was made at once, and intense interest was taken in the subject. A photograph made by Ritchey at the Yerkes Observatory, on November 9, afforded full and independent confirmation of Mr. Perrine's remarkable discovery. Photographs made at intervals throughout the winter have enabled us to follow the motions of the brighter masses.

Later examination of our early photographs of this region, by Mr. Perrine in January, 1902, led to the discovery that two rings of nebulosity surrounding the new star were beautifully recorded on the plate of March 29. We were thus able to extend the history of the phenomenon backward five months.

The nature of the phenomenon is a mooted question. The favorite theory is that invisible masses of nebulosity existed in this region previous to the formation of the new star; and that the great wave of light, sent out when the brightness of the star was at a maximum, was sufficient to illuminate the dark masses and make them visible to us by reflected light. Bearing upon this question, Mr. Perrine secured valuable polariscopic evidences. A photograph of the nebula was obtained after passing the light through a double-image prism, placed at a short distance in front of the plate holder in the Crossley Reflector. Two images of each of the principal nuclei were recorded in such a way as to make it certain that the polarization effects to be expected from reflected light are entirely absent.

The consensus of opinion is that the new star is the result of a violent collision between two dark stars, or between a dark star and a nebula. It can easily be shown that the kinetic energy of two such bodies,

approaching and colliding with enormous relative speed, would be converted into heat in sufficient quantities to transform the dark bodies into incandescent gases. The history of previous new stars had led us to expect that the spectrum would gradually change into that of a nebula, and in this we were not disappointed. For a suitable study of the present nebular spectrum of the new star it was necessary that further and more accurate investigations be made upon the spectra of the well-known nebulæ. These investigations were undertaken with great success by Assistant Astronomer Wright. He determined the positions of many well-known nebular lines more accurately than had previously been done, and a number of very interesting new lines were detected.

Very little attention has been given to the subject of comet-seeking, on account of pressure of work in other lines.

Micrometer observations of comets in the past two years have been secured, as follows:

Comet *a* 1900,	Aitken	3 nights,	Perrine	4	nights.
" *b* 1900,	"	10 "	"	3	"
" *c* 1900,	"	6 "			
" *a* 1901,	"	2 "			
" *a* 1902,	"	2 "			

Valuable photographs of comet *a* 1901 were secured by Mr. Perrine at the Eclipse Station in Sumatra. An orbit of comet *b* 1900 was computed by Mr. Perrine, and of comet *c* 1900 by Mr. Aitken. Some very interesting photographs of comet *b* 1900 were secured by Mr. Palmer.

Extensive series of measures of satellites of planets were obtained by various members of the staff, observations being limited in all cases to those most desired by investigators of their orbits.

Two hundred and fifteen observations of the relative positions of the satellites of Saturn were made by Mr. Hussey with the thirty-six-inch equatorial.

Mr. Aitken made the following observations with the thirty-six-inch equatorial:

Satellites of Uranus,	27	nights.
" " Neptune,	13	"
" " Mars,	7	"
Fifth satellite of Jupiter,	2	"

At the request of Professor Newcomb, Mr. Perrine photographed the planet Neptune and its satellite on thirty plates, in January, 1902, with the Crossley Reflector. The measurements of these plates furnish fifty-one determinations of the position of the satellite, with reference to its primary. Photographic methods have been but little used in this line of work, and it is interesting to note that the smallness of the errors of observation justifies the application of the method in all possible cases.

The work with the meridian circle has been most efficiently prosecuted. Since July 1, 1900, Mr. Tucker has obtained 6,500 complete observations. These include observations of Eros comparison stars; of Eros itself; of Nova Persei; and of zodiacal stars, greatly needed at the present time, to be used as a basis for improving the orbits of the major planets.

The manuscript for 'Lick Observatory Publications,' Volume VI., is entirely ready for the printer. The volume will contain results of meridian circle work from July, 1896, to March, 1901, and will include about 14,000 complete observations of 4,500 stars.

Fellow R. T. Crawford assisted in meridian circle work during the years 1898–1901. At the end of his service he received the degree of doctor of philosophy, having taken for his thesis the subject of 'The Refraction Constant at Mt. Hamilton.'

The department of astronomy known as double stars has been most ably advanced by Messrs. Hussey and Aitken. Their programs have been admirably developed and systematized, and results of prime importance have been surprisingly

numerous. It is not too much to say that their discoveries and observations of new double stars, and their measures of known double stars, outnumber several-fold the corresponding output of all other observatories in the past two years. Both observers have devoted a portion of their time to the discovery of new pairs. Mr. Hussey has found 312 systems in the past two years, and 564 since 1898. They may be classified as follows:

Distances between	0″.00	and	0″.25,	41	pairs.
	0 .26	"	0 .50,	103	"
	0 .51	"	1 .00,	123	"
	1 .01	"	2 .00,	128	"
	2 .01	"	5 .00,	168	"
		Over	5 .00,	1	"
			Total	564	"

The corresponding discoveries by Mr. Aitken have been 249 since July, 1900, and 345 since 1898, as follows:

Distances between	0″.00	and	0″.25,	20	pairs.
	0 .26	"	0 .50,	55	"
	0 .51	"	1 .00,	78	"
	1 .01	"	2 .00,	91	"
	2 .01	"	5 .25,	101	"
			Total	345	"

By way of explanation, it should be said that in general the closer the components of a pair the more interesting and important it is. The majority of stars in which orbital motions have been detected are closer than 1″. Up to the present time about 1,500 double stars with distances under 1″ have been discovered at all the observatories. More than one third of these have been found at the Lick Observatory, and more than one fourth of the whole number have been discovered here within the last three years.

Many interesting results have come from the systematic observation of the well-known interesting pairs. Of these, the most striking case is Delta Equulei. It was supposed that its period of revolution was eleven and four tenths years—surpassed in rapidity of motion only by Kappa Pegasi, period eleven and one third years. In the fall of 1900 it was noticed by Mr. Aitken that the components of Delta Equulei were not following the paths marked out for them by the orbit hitherto accepted as substantially final. Mr. Hussey investigated the question of their orbit, making use of all the known observations. He came to the conclusion that the chances were greatly in favor of a period only one half the length of that previously assumed, namely, five and seven tenths years. Systematic observations by Messrs. Hussey and Aitken during the past year have established the correctness of this view. The period of this interesting binary is fifty per cent. shorter than that of any other known double star. Observations of this system obtained with the Mills spectrograph are in harmony with Mr. Hussey's theory.

Mr. Hussey has also in the past two years secured 1,899 observations of W. Struve, Otto Struve, miscellaneous and new doubles.

Mr. Aitken has obtained 1,431 observations, his observing list being mainly composed of known rapid binaries, and other close and difficult pairs. He has likewise computed orbits for 99 Herculis, Zeta Sagittarii and Beta Delphini.

Mr. Hussey completed his observations and discussions of the Otto Struve Double Stars, and his work was issued in the summer of 1901 as Volume V., 'Publications of the Lick Observatory.'

The Crossley Reflector has been busy on practically every good night. In addition to the observations already referred to, Messrs. Palmer and Dall made thirty-three exposures on the nebulæ contained in Professor Keeler's program, in the first half of 1901. Mr. Perrine has since secured twenty-three exposures on these nebulæ, twenty-eight exposures on the Rumford

variable star regions referred to above, and twenty-five exposures for miscellaneous purposes.

A small slitless spectograph was designed by Professor Keeler for use on faint objects with the Crossley reflector. It was completed on the day of his departure from the mountain. It was tested promptly by Messrs. Campbell and Palmer, who found it necessary to use convex and concave quartz lenses in connection with the quartz prism, in order that the rays should be parallel when passing through the quartz prism. These changes were designed by Mr. Palmer, and the instrument was used extensively by him. He secured seventy spectrograms of the smaller planetary nebulæ and of other small objects. Many interesting facts resulted from these observations. I shall refer only to his success in photographing extremely faint spectra. A strong image of the spectrum of Nova Cygni, visual magnitude about 15.5, was obtained with ease. Successful exposures could probably be made on stars at least a magnitude fainter. His photograph of Nova Cygni demonstrates that the spectrum, which was nebular in 1877, has now become continuous, like that of the ordinary stars.

In addition to the observations of Eros, positions of asteroids 1900 GA, Ohio, and Palatia, were determined by Mr. Palmer, from photographs taken with the Crossley reflector. Mr. Hussey secured eight observations of the asteroids Minerva, Edna, 440, and Chicago. Messrs. Palmer and Curtiss have recently secured photographs of several asteroids whose positions were requested.

Three nights per week with the thirty-six-inch equatorial have been devoted to the determination of the motions of the brighter stars in the line of sight, with the Mills spectrograph, during the past six years. The accuracy of the Lick Observatory determinations has steadily progressed until, for the stars containing fine lines, the probable error of a single determination of velocity is only about 0.25 kilometer.

To the list of fifteen spectroscopic binaries discovered prior to Director Keeler's report of July 1, 1900, I desire to make twenty-three additions, as follows:

Beta Herculis,	12 Persei,
Xi Ursae Majoris	93 Leonis,
Delta Bootis,	Beta Scuti,
113 Herculis,	2 Scuti,
Eta Andromedæ,	Kappa Pegasi,
Pi Cephei,	31 Cygni,
Xi Piscium,	Tau Persei,
Xi Prime Ceti,	Epsilon Hydræ,
Delta Equulei,	Alpha Equulei,
Zeta Herculis,	Phi Persei,
Omicron Andromedæ,	Eta Geminorum.
Gamma Canis Minoris,	

These thirty-eight systems have been discovered since 1898.

There is room for reference to only two of the stars on the above list: Zeta Herculis is a short-period visual binary star, completing a revolution in about thirty-three years. The velocity of the principal star in the line of sight is slowly varying. Kappa Pegasi is one of the most interesting visual binaries known, period eleven and one third years. Until the discovery of the true period of Delta Equulei, this was supposed to be the shortest period known. One of the components of Kappa Pegasi is a spectroscopic binary, having a period of only six days.

These binary systems have been discovered in the process of determining the velocities of about 350 stars; in this list of 350 previous observers had discovered three binaries. Without taking into account a list of several suspected binaries, it is apparent that of the brighter stars at least one in every seven or eight is attended by an invisible companion. When we con-

sider that spectroscopic methods are at present capable of discovering only the larger variations, that very few stars of long periods have probably been advantageously observed as yet, and that the velocity of our sun, due to the orbital motions of the planets attending it, has a double amplitude of only two or three hundredths of a mile per second, there can be no doubt that the number of spectroscopic binaries must be very great. It is probable that the star unattended by dark companions will be found to be the exception rather than the rule.

Mr. Wright has computed the orbit of the spectroscopic binary Chi Draconis; Dr. Reese, that of Capella; Director Campbell, that of the variable star and spectroscopic binary Zeta Geminorum; and Dr. Crawford, that of Eta Pegasi.

Dr. Reese investigated the question of the diffraction of light of variable intensity, with special reference to the Mills spectrograph, as a guide in designing a more powerful instrument. He has likewise investigated the cause of the discrepancies between measures of spectrograms made with the violet end to the left, and with the violet end to the right, as a result of which he established the purely physiological cause of the discrepancy.

Dr. Reese has also designed a new mounting for the Mills spectrograph.

Photographs and preliminary measures of several hundred spectra have been made by Messrs. Campbell, Wright and Reese; and a considerable number of definitive measures have been made.

In December, 1900, the director utilized the results obtained for the velocities of 280 stars situated north of —20 declination in determining the speed and direction of the motion of the solar system through space. The result for the speed of the solar system comes out 19.9 kilometers, or 12.4 miles per second. The apex of the motion is in R.A. 277° 30′, declination +20°. The result for speed is very satisfactory. On account of the absence of material from the southern hemisphere, and the consequent irregular distribution of the observed stars over the sky, the direction assigned must be regarded as a rough approximation.

The average velocity in space of the 280 stars is 34.1 kilometers per second. The velocity of the solar system is therefore much less than the average for the other stars.

Another result of great interest is to the effect that the fainter stars are moving much more rapidly than the brighter ones.

The velocities of the stars have been observed to bear all values between sixty miles approach and sixty miles recession per second.

Investigations in this line have been shown to be practically endless, by our measurements of the velocity of the star Groombridge, 1830. A special effort was made to measure its velocity, as this is the star which up to three years ago had the largest known proper motion. Its photographic magnitude is in the neighborhood of 7.5. The results obtained have shown that the observations may be extended by present methods to stars perhaps a magnitude fainter. Stars available for measurement are therefore numbered by thousands. As soon as half a dozen of the eight or ten great telescopes now engaged in this work have been made to produce accurate results, it will be highly desirable that the interested observatories arrange and carry out a scheme of cooperation on a large scale.

From Mt. Hamilton it is possible to secure the speeds of the stars between the north pole and 30° south declination. The stars in the quarter of the sky from 30°

south to the south pole remain unobserved. For many years it has been my desire to organize an expedition to the southern hemisphere for the purpose of measuring the velocity of these stars. With the approval and endorsement of the president, the subject was brought to the attention of Mr. D. O. Mills, who most generously offered to provide funds for constructing the instruments, for defraying traveling expenses, and for paying the salaries of the astronomers engaging in the work.

For this work, a Cassegrain reflecting telescope is nearing completion. The parabolic mirror of thirty-six and one half inches clear diameter and the convex mirror of nine and four tenths inches are being constructed by the John A. Brashear Company.

A powerful three-prism spectrograph, designed by the director for use with the reflecting telescope, is completed. The delicate parts of the mounting were constructed by our instrument-maker, and the optical parts by the John A. Brashear Company. Mr. Wright has submitted the whole spectrograph to severe tests. Its performance appears to be superior even to that of the original Mills spectrograph. A modern steel dome was built for the expedition by the Warner and Swasey Company. The minor pieces of apparatus required have all been provided. It is planned to select a suitable observing station in the vicinity of Santiago, Chili. It is confidently hoped that this work will be at least as fruitful as that carried on with the Mills spectrograph attached to the thirty-six inch equatorial.

The director wishes to make full acknowledgment of the enthusiastic support afforded him by the members of the observatory staff. Every man has been ready to make the most of the opportunities supplied by the splendid instruments, by the unexcelled climatic conditions, and by the excellent policy inaugurated for the observatory by the officers of the University of California.

W. W. CAMPBELL,
Director of the Lick Observatory.

SCIENTIFIC BOOKS.

Der Hercynische Florenbezirk. Grundzüge der Pflanzenverbreitung im mitteldeutschen Berg- und Hügellande vom Harz bis zur Rhön, bis zur Lausitz und dem Böhmer Walde. Von O. DRUDE. Leipzig, Engelmann. 1902. Pp. xix + 671.

This is the sixth volume in the series of monographs of Engler and Drude under the general title of 'Vegetation der Erde.' Having been specially elaborated by Dr. Drude, it may be taken to represent the standard adopted and the principles which it is designed to embody as the work progresses farther. The region covered includes central Germany, and is familiar to the author, as he tells us, through thirty years of field and herbarium work.

As indicated in previous volumes, the scope of the general work is a study of the vegetation of the earth from the standpoint of geological development, on the one hand, and adaptations to environment, on the other. By a natural division of material and labor, two lines of work have been developed, namely, floristic observations and the study of biological relations. It is to the first of these that the present volume is mainly, though not exclusively, devoted.

The discussion of geographical and climatological data is followed by a brief statistical résumé, in which it appears that, within the limits of the Hercynian region, 1,564 vascular plants occur, besides some 645 species of bryophytes, and possibly 2,000 or more thallophytes. The flora is a composite in which occur numerous Baltic elements associated with northern Alpine forms, and in which north Atlantic species as well as circumpolar Arctic ones are also represented. There are in the whole region but few, and these not strongly marked, species that do not occur in

neighboring regions. The greatest floral contrast exists between the Hercynian flora and that of northwestern Germany; closer relations are manifest toward the east, south and west.

The species composing the German flora are referred to eleven natural areas of distribution, among which are the boreal, Alpine, Ural, Pontic, Atlantic and Arctic. A detailed study of the present distribution of species belonging to these various areas renders possible a discussion of the paths along which the existing floral elements of Germany have migrated at different periods. Naturally, the degree to which the elements from a particular area become dominant determines more or less the tone of the landscape in any given district.

The body of the work is devoted to an account of plant societies, of which thirty-two are distinguished, and to the distribution of these societies and their character species in fourteen natural districts of central Germany The descriptions and enumerations are sc definite and inclusive as to present for every one of these districts a satisfactory picture of floristic relations. The author's contributions and methods in this direction are so well known as to render their present discussion unnecessary.

The fifth and last division of the book is devoted to a consideration of the causes, past and present, that have contributed to the establishment and characteristics of the Hercynian flora as it is to-day. As a matter of fact, 'Hercynia' does not suggest a simple unity as a vegetation region; the unity is rather geographical, and there are included within it a number of vegetation regions which may lie alongside of each other in the plain, and above one another on the mountains. Immigrations have been controlled in the first place by orographic structure and edaphic conditions, determined by the substratum, which consists of crystalline rocks, basalt, and, especially in the west, of Triassic limestone. Climatic factors, in themselves alone, and in connection with physiographic features, and the chances of immigration along natural favorable routes are also all tc be taken into account. It is particularly difficult to form an exact estimate of purely climatic influences on the delimitation of Hercynian districts and landscapes. Westward from the Harz, for example, Atlantic species have settled, favored by the greater amount of moisture, while in the same latitude eastward there is a great development of Pontic groups on the dry triassic soils. The same *Ilex* that grows wild in the neighborhood of the Weser is more likely to freeze in severe winters to the southeast of the Harz. Certain cereals sensitive to excess of precipitation, such as the finer varieties of barley, yield the best harvests along the lower Saale, but all these and numerous other well-known facts are the result of a complex of causes in which general climatic relations must be recognized but are by no means the exclusive factor.

This leads naturally to a discussion of geological relations, which, though brief, is highly suggestive, and is of the more value in that the author, with such abundant data at his disposal, attempts only in the most conservative way theoretical constructions that have often proved of seductive interest. He holds that there is no ground for the assumption that Germany was ever in the condition of Greenland of the present day. Relicts, such as *Hymenophyllum* and various other genera, prove that the last time of glaciation in the Hercynian hill country did not destroy all the remnants of the preceding period. A historical succession may be recognized in which Arctic tundra are followed by a northern steppe flora, which in its turn gives place to forest. Relicts of these different periods are still living together, and in some places have formed remarkably mixed societies.

Drude discusses in some detail the traces of the ice age in subalpine heaths and moors of the Hercynian Mountains, showing that, with the advance of the ice, alpine species as well as the old stock of Scandinavian forms were driven southwards, that finally along the border of the inland ice stretching from the Elbe northeast through Prussia there must have been an exchange of such species, so that hill country, such as that of Hercynia,

lying in the line of this interchange would be settled by Scandinavian, boreal-Ural and alpine-Carpathian plants. Naturally, also, during the fluctuations of the last glaciation, and especially during the retreat of the ice, a mixture of the highest forest and lowest subalpine societies would take place.

Traces of the steppe period, exemplified in the dry hill and rock plants, correspond with the 'præalpine' societies that occur on the limestone and dolomite slopes of the northern Alps. If we picture to ourselves the time when, after the warm interglacial period, a later glaciation took place, it must be taken for granted that the præalpine grove and rock plants were driven down before the ice and settled on other limestone hills at a lower level. These afterwards mixed in various places with plants of Pontic origin, which also chose dry marl and calcareous soils to settle on. These Pontic elements came in from the east along paths which may still be traced with a considerable degree of assurance. Thus along the Elster, the plants of the Saale (including various præalpine and Pontic species) are not most thickly distributed simply where there is the greatest extent of limestone rocks, but rather in places that these plants could most easily reach, and this depends on the position of valleys free from forests. Along the shortest line from the Saale to the Elster extends a plateau of muschelkalk, and it is exactly in this direction to the eastward that the hills on the Elster reproduce most fully on their south and west sides the flora of the hills along the Saale. Thus the natural geographical paths for post-glacial settlement have been reinforced by favorable edaphic and climatic conditions, and all of these must be taken into consideration in attempting to account for the history of the present Hercynian flora. But until the geological history is more fully and certainly known it is impossible to construct, with any hope of accuracy, such a system as, for example, that attempted by Schulz, who assumes four periods of warmth alternating with as many of glaciation, and undertakes to trace the periods and course of immigration for single species.

Since the glacial period the orographic features of Hercynia have not been essentially altered, and then, as now, climatic and edaphic factors were together determining the immigrations of plants. It is very probable that at the time of the Pontic invasion the region of the lower Saale had a more distinctly steppe climate than other parts of Hercynia, and that the triassic soils which to-day favor the plants inhabiting them offered corresponding advantages to such settlers then. In manifold other ways the continuity of present with past physiographic conditions becomes increasingly obvious, and the present study is a noteworthy recognition of the necessity of admitting this principle to the fullest extent in attempting to construct a satisfactory picture of the historical succession of plant societies. The attainment of such an ideal, though beset with extraordinary difficulties, is being brought nearer through the indefatigable labor embodied in this and the companion volumes of the 'Vegetation der Erde.'

V. M. Spalding.

The Archeological History of Ohio. By Gerard Fowke. Columbus, O. Published by the Ohio State Archeological and Historical Society, 1902. 8, XVI.

Mr. Fowke's book is not written, so he claims, for scientists or specialists, but to give laymen an idea of the extent and characteristics of the prehistoric remains found within the borders of the state of Ohio. It fulfils its mission and presents in its 760 pages a complete résumé of all the antiquities of the state, and also refers to nearly every publication upon the subject. The work is well done, and as Mr. Fowke compassed a task which required a great deal of time, and would not have been possible to any person who had not studied the Ohio field, as he has, for twenty years, he is deserving of our meed of praise.

But while the above is true, the book itself may not further the study of archeology in the United States. Unfortunately the author is even more than controversial, he is dogmatic, and to most of the writers and authorities on Ohio antiquities, he is unjust. Such a book as this is, evincing years of study in

its preparation, may do a deal of harm or an equal amount of good. That is, it may give an erroneous conception of the culture of the mound-building tribes in Ohio. A scientific critic should be infallible. Mr. Fowke is not infallible. Beginning with the year 1803 and coming down to the present, he has resurrected the published opinions of scores of writers, and has held up their theories to ridicule and contempt. But they were the pioneers in American archeology. These men made many mistakes. It would be as logical for one interested in the development of steam navigation to contrast Fulton's steamboat with the *Kaiser Wilhelm der Grosse* to the detriment of Fulton, as it is for Mr. Fowke to measure these pioneers by our present standard of knowledge.

The whole tone of the book is that prehistoric man in Ohio is scarcely worthy of study; that nothing new has been learned regarding him; that (p. 148) "Our museums are filling up with material from all these sources, and yet, for years, the accumulation has added nothing in the way of real information to what we already knew."

If this is true, why continue work in prehistoric anthropology?

Mr. Fowke does not believe the prehistoric earthworks and mounds required the time in their construction assigned by other investigators, who made many exaggerations. But he presents a rather illogical argument. I have space for only part of it.

"Forty deck hands on a western steamboat, working steadily, will transfer ten thousand bushels of corn from the bank to the vessel in one day. An equal weight of dry earth will make a mound forty feet in diameter and ten feet high" (p. 85). No Indian ever worked as deck hands work. The corn in sacks and usually handled on trucks, is rushed from the deck into the warehouse, the negroes stimulated to run by the curses of the mate. Mr. Fowke places the natives, who had no shovels, no trucks, and no inclined planes or board floors on which to move the 'dry earth'—even as negroes hustle sacked corn—on a par with the fastest workers of modern times. The field testimony is that the earth for mounds was scooped up in the immediate neighborhood and carried in baskets or skins. This was naturally a slow process, as the natives used stone or shell digging tools.

On page 88 there is a sentence which is calculated to prejudice the author in the eyes of fair-minded men. Mr. MacLean, in one of his books, refers to the mound-builders as selecting the region between the lakes and the gulf, the reason for which is apparent to any observer. As to this opinion, Mr. Fowke says, 'The last quotation is about as sensible as to say that a man displayed great literary inclination by electing to be born in Boston.'

He contends that the number of rings in a tree is no evidence as to its age, to all of which we may subscribe. But, unfortunately, he cites all the trees of rapid growth in support of his argument, even bringing in trees of tropical regions, as in Yucatan, where M. Charnay found trees twenty-two years old two feet in diameter. As to the great oaks four or five feet in diameter, found on some of the earthworks, he has nothing to say.

Mr. W. C. Mills's important investigations of the last few years are almost entirely omitted. In many places Squier and Davis are cited because their measurements are not in accord with those of the author, who ignores the fact that the diameter of an embankment or of a mound may have been enlarged many feet through continuous cultivation. The Hopewell exploration, for example, showed that the Effigy mound was originally much higher and narrower than even in Atwater's time; to-day it is nearly one half larger and broader than it was found to be in 1891. Applying to this Mr. Fowke's method of reasoning, the structure could never have had the dimensions assigned to it by early observers.

The chapter on Flint Ridge gives an exhaustive account of that famous site. The pages devoted to the manufacture of implements and to the finished products are also, with the exception of a few remarks on ceremonial stones, above criticism. In such descriptions and in field work the author is seen at his best, and the critical student would be

unjust did he not accord due praise in these directions. It is only in Mr. Fowke's attitude toward others, in which there is manifest such a spirit of intolerance, that he is open to severe criticism.

His conclusions are that several tribes may have occupied Ohio (p. 470), yet he does not agree with the 'long and short heads' theory.

He uses the terms 'tribe' and 'race' interchangeably throughout his book. He says mound finds and surface finds differ little—a statement not borne out by field testimony. Different sites present varying degrees of culture, and the Turner site where Putnam found so many evidences of a considerable advance in art, and the Hopewell where substances from the Yellowstone, the Gulf and other distinct points, together with beautiful carvings in stone and bone, were exhumed, are classed with sites which evince a very low degree of culture.

No sensible person believes in 'civilization of the Mound-builders' or that there was a 'race of Mound-builders.' But to swing to the other extreme and classify a tribe able to construct the strange 'combination-works' of the Lower Scioto with the Pai Utes or the Comanches is manifestly wrong.

Warren K. Moorehead.

Andover, Mass.

The Minerals and Mineral Localities of Texas. By Frederic W. Simonds, Ph.D., Professor of Geology, the University of Texas. Bulletin No. 5, The University of Texas Mineral Survey, December, 1902. Pp. 104.

In the 'Letter of Transmittal' Dr. Wm. B. Phillips, director of the survey, says: "In view of the deep interest now being shown in the mineral resources of the state, we thought it advisable to issue a special publication dealing with the mineral and mineral localities. Dr. Simonds has been engaged upon this work for some time, and it is believed that the list he now presents covers the entire field as well as it can be done at present."

The task Dr. Simonds set for himself was a very arduous one, and it is to his credit that the list 'covers the entire field as well as can be done at present.' It is by far the most comprehensive, and at the same time authentic, list of the minerals and mineral localities of Texas that has been published, and Dr. Simonds has done the state a real service in putting in accessible form so much valuable information concerning these particular resources of the state.

The minerals are listed alphabetically, with numerous cross-references, and this list covers eighty-four pages of the bulletin. Next follows 'A Summary of the Minerals of Texas by Counties'; then notes on the scale of hardness, specific gravity, streak, luster, fracture; and the bulletin closes with a discussion of 'The Commercial Aspects of Certain Ores in Trans-Pecos, Texas,' by Dr. Wm. B. Phillips, Director of the Survey.

The work is well done, and is worthy of better treatment than it received at the hands of the printer. The poor quality of the paper used and the numerous typographical errors—errors solely attributable to gross negligence on the part of the printer—must be a disappointment to the author. The neglect of the printer to follow 'copy' with regard to proper spacing in a large number of the chemical formulæ is very reprehensible. On page 72 the omission of the letter 'y' in the word pyroxene is inexcusably bad in a list alphabetically arranged, but the insertion, on page 94, of the word 'pounds' instead of the word 'points' under the scale of hardness, is infinitely worse.

H. W. Harper.

February 23, 1903.

SCIENTIFIC JOURNALS AND ARTICLES.

The March number of the *Botanical Gazette* opens with a contribution from the Cryptogamic Laboratory of Harvard University by Dr. Roland Thaxter, entitled, 'New or Peculiar North American Hyphomycetes.' In this, the third paper of the series, he describes two new genera, containing three species, *Heterocephalum aurantiacum, Cephaliophora tropica* and *Cephaliophora irregularis*, illustrated by two lithograph plates.—In the conclusion of his paper on 'Chemical Stimulation and the Evolution of Carbon Dioxid,' Dr. Edwin B. Copeland shows that metallic poisons drive off CO_2 from the carbonates in

the cell sap of water plants, such as *Elodea* and *Ceratophyllum*. This pseudo-respiration under the action of strong poisons is many times as active as the real respiration and makes the study of the latter impossible. Carbon dioxid is also given off from filtered sap expressed from *Elodea* more rapidly than from the living plant. He also finds that the evolution of CO_2 is a feature of the breaking down of protoplasm into mere proteid in death, and that it continues for a considerable time after death.—Professor John M. Coulter and Dr. Charles J. Chamberlain discuss the 'Embryogeny of *Zamia*.' The results of that study, taken in connection with previous work, enable them to arrange the gymnosperms in a developmental series. It appears that the embryogeny of *Ginkgo* is the most primitive among gymnosperms, that of *Cycas* more primitive than that of *Zamia*, while *Zamia* approaches more nearly the Coniferales; that such forms as *Taxus, Cephalotaxus, Podocarpus, Taxodium* and *Thuja* show progressive stages from the embryogeny of *Zamia* toward that of *Pinus*; that *Ephedra* has the most primitive embryogeny among the Gnetales; and that *Gnetum* and *Tumboa* resemble the angiosperms in the elimination of free nuclear division from their embryogeny.—Professor Bruce Fink describes some *Cladonia* formations occurring on the talus of cliffs in northeastern Minnesota. The region is a remarkable one for the growth of these interesting lichens. Photographic illustrations show the way in which the talus blocks are gradually covered with lichen societies.—Mr. Howard S. Reed describes 'The Development of the Macrosporangium of *Yucca filamentosa*,' which shows certain interesting deviations from the mode in other Liliaceæ.—Mr. J. M. Greenman remarks that his new genus *Faxonanthus*, recently described in Sargent's 'Trees and Shrubs,' accidentally without indication of relationship, belongs to the family Scrophulariaceæ, and is allied to the genus *Leucophyllum*.—Mr. A. S. Hitchcock publishes nomenclatural notes upon *Andropogon divaricatum* and *Dactylis cynosuroides*. Küster's 'Pathologische Pflanzenanatomie,' Strasburger's 'Das botanische Practicum,' and Wiesner's 'Die Rohstoffe des Pflanzenreiches' are reviewed, together with a large number of papers in current literature.

The Popular Science Monthly for April opens with a translation of Hugo de Vries' memoir, 'On the Origin of Species.' This is followed by the ninth instalment of 'Mental and Moral Heredity in Royalty,' by Frederick A. Woods, who states that heredity appears to have exercised in mental life a factor not far from nine tenths, while on the moral side it is something over one half. Under the title 'The Great Auk in Art,' Frank Bond gives a considerable series of pictures of this bird gathered from various sources, accompanied by the descriptions of different authors. T. D. A. Cockerell discusses 'The Making of Biologists,' presenting evidence to show that much depends on natural bent and out-of-door surroundings, and Glenn W. Herrick considers 'The Relation of Malaria to Agriculture and Other Industries of the South.' He shows that malaria increases the death rate and that the loss of time it causes is a very serious drawback to agricultural prosperity. Albert M. Reese has an interesting article on 'The Habits of the Giant Salamander,' though the animal referred to is the North American *Cryptobranchus* and not, as one would naturally suppose, the really giant Japanese species. J. Howard Gore has a paper on 'The Carnegie Institution and the National University,' and in 'Biography in the Schools' David R. Major and T. H. Haines present facts implying a decided lack of biographical knowledge on the part of the average student. Charles A. White describes 'A Visit to the Quarry Caves of Jerusalem,' and Sir Benjamin Baker the construction of 'The Nile Dams and Reservoir.' 'The Progress of Science' contains various items of general interest and the index to Vol. LXII. completes the number.

The Museums Journal of Great Britain has an article on 'Voluntary Help in Museums,' suggesting that a museum might obtain much assistance from parties not on its staff, but

interested in its welfare. Ernest Lowe, of the Plymouth Museum, describes 'The Registration and Numeration of Museum Specimens' as practiced in that institution and the editor invites other papers on that subject. 'An Outsider's View of Museums and the Public' suggests that the latter does not appreciate the instruction to be found in museums. The balance of the number is filled with notes regarding British and foreign museums.

The Plant World for March contains the fourth instalment of 'Notes from the Note Book of a Naturalist in Guam,' by William E. Safford; 'Another Use for the Royal Palm,' by William Palmer; 'Spontaneous Fission of Olive Trees in Palestine,' by Charles A. White, and 'Botanizing in a Cactus Bed,' by Charles F. Saunders.

In the *Proceedings of the American Academy of Arts and Sciences* W. E. Castle gives a very clear exposition of the main features of 'Mendel's Law of Heredity,' accompanied by illustrations of its workings. It is only to be regretted that this useful paper is not published where it would be more generally accessible to the many who wish to know just what Mendel's law is, but do not care to spend the time to look up articles relating to it.

Number 9 of Volume V. of the *Memoirs of the Boston Society of Natural History* is devoted to a detailed description of 'The *Skeletal System of Necturus maculatus*,' by Harris H. Wilder. This is accompanied by several plates which admirably illustrate the features of the skeleton. The author hopes that as occasion offers he may add to this papers on other systems of *Necturus* and thus give a complete monograph of a typical tailed amphibian.

SOCIETIES AND ACADEMIES.

AMERICAN PHYSICAL SOCIETY.

The regular winter meeting of the Physical Society was held at Columbia University, New York city, on February 28, 1903.

In a paper on the 'Nucleation of the Atmosphere During Cold Weather,' by Carl Barus, the author presented the results of recent work with his coronal methods of counting the number of condensation nuclei in the air. These nuclei were found to be present in abnormally large numbers during the very cold weather of December and January. Curves were exhibited showing a remarkable parallelism between fall of temperature and rise of nucleation. Three alternative hypotheses were mentioned by Professor Barus in explanation of the results, viz., a current from the upper air rich in nuclei may be brought down by the cold wave; or the formation of water nuclei may bring down an air stratum overlying cities; or the water nuclei may be radioactive at low temperatures and thus produce other nuclei by ionization. Experiments are in progress to test the latter hypothesis.

A second paper by the same author dealt with the 'Ionization and Nucleation of the Phosphorous Emanation.' The results show that while the ionization produced vanishes very quickly, the coronas due to condensation on the nuclei present last for a relatively long period. In this case, therefore, there appears to be no relation between ionization and nucleation.

Professor Barus also described an interesting and simple 'Method of Determining the Ratio of the Velocities of the Ions in Air,' depending on the rate of dissipation of charge from a point. The value obtained for the ratio of the velocity of the negative ion to that of the positive ion was 1.32, which agrees closely with the values obtained by other methods.

A paper on 'Diffusion and Supersaturation,' by H. W. Morse and G. W. Pierce, described quantitative experiments based upon an experiment originally due to Liesegang. When the end of a capillary tube containing a solution of potassium chromate is dipped into a water solution of silver nitrate, the silver nitrate diffuses up into the tube and throws down a precipitate of silver chromate. The silver chromate, instead of growing continuously as diffusion proceeds, forms in distinct layers widely separated in comparison with the thickness of the layers. Measurements were made of the distances between these layers and the time was observed at which each suc-

cessive layer was formed. The results obtained agreed in a very satisfactory manner with the theory of diffusion and made it possible to determine the value of the 'metastable solubility product.' The value found indicated that at the limit of supersaturation the solution contained 145 times as much silver chromate as is required to form a precipitate in the presence of the solid phase.

A paper on the 'Rôle of Thermo-Electromotive Forces in a Voltaic Cell' was presented by H. S. Carhart. The writer considered briefly the theory of a voltaic cell, so far as relates to the properties dependent on temperature, and showed that all these could be completely explained by means of electrolytic thermoelectromotive forces between a metal and the liquid in contact with it. Numerous experiments were described whose results were in agreement with the theory.

In a paper entitled ' A Simple Geometrical Principle and its Possible Relation to a General Physical Theory,' Major J. Millis gave an account of the possible modes by which a number of equal spheres may be grouped. It was shown that the grouping that is symmetrical and capable of indefinite extension by the addition of more spheres is not the arrangement that gives a minimum total volume. The possible bearing of this fact upon molecular theories was suggested.

Dr. J. R. Benton described a 'Method of Determining Internal Resistance, Applicable to Rapid Polarizing Cells.' The method is a modification of that of Beetz and gives more accurate results. It also has the advantage that it can be used for cells of small electromotive force and resistance.

The next meeting of the Physical Society will be held on April 25.

ERNEST MERRITT,
Secretary.

NEBRASKA ACADEMY OF SCIENCE.

THE thirteenth annual meeting of the Nebraska Academy of Science was held in Lincoln, Nebr., January 22 and 23, 1903. President Charles Fordyce, Dean of Nebraska Wesleyan University, presided.

The following papers were read:

'The Causes of Metamorphosis in *Amblystoma tigrinum*,' Dr. J. H. Powers. The metamorphosis of *Amblystoma tigrinum* is not, as has been generally assumed, due to enforced aerial respiration; neither is it affected within wide limits by variations in light or heat stimulus. The active causes are variations in metabolism due to fluctuations in food supply. Sudden checks in food supply lead to immediate metamorphosis, slow and constant food supply postpone metamorphosis and prolong growth in larval stage.

'Sand and Gravel Industry in Nebraska,' Dr. G. E. Condra.

'Summary of Study of fifty-seven Cases of Phenomenal Chest Expansion in Nebraska Schools,' Dr. W. W. Hastings.

'The Diagnosis of Human Parasites,' Dr. H. B. Ward. In this paper Dr. Ward dealt especially with the necessity of more accurate knowledge concerning the eggs of parasites, and concerning the other evidence upon which differential diagnoses might be made.

'Absorption of Starlight by our Atmosphere,' Professor G. D. Sweezey.

'Wave Erosion on the Western Shore of Lake Huron,' Dr. C. H. Gordon.

'A Final Report of the Washings of the Missouri River,' Professor H. B. Duncanson. Professor Duncanson showed the regularity of the shifting of the bed of the Missouri River, and the laws governing the constant gradual backward and forward movement of the channel in the river valley.

'An Old Channel of the Platte,' Dr. G. E. Condra. Dr. Condra, by means of maps and sketches, showed clearly the nature of the broad valley passing from northwest to southeast north of Wahoo, Nebr., which seems clearly to have been a former Platte channel.

'Common Sense and Computation,' Dr. E. W. Davis. A paper devoted to showing errors resulting from continued use of too many decimals in computation.

'On The Paramorphic Development of Hornblende from Augite,' Dr. C. H. Gordon (read by title).

'On the Pyroxenites of the Greenville

Series of Ottawa County, Canada,' Dr. C. H. Gordon (read by title).

'Notes and Descriptions of North American Bees,' Mr. J. C. Crawford, Jr. (read in abstract).

'Florence Flint; Its Production and Uses,' Dr. G. E. Condra. A recently discovered building stone found in southern Nebraska.

'Notes and Descriptions Leading to a Monograph of the Telamonini,' Mr. W. Dwight Pierce (read by title).

'A New Species of *Japyx* from Nebraska, with a Synopsis of North American Species,' Mr. Myron H. Swenk (read in abstract).

'Conditions Serving to Influence the Fauna of Nebraska,' Dr. R. H. Wolcott. The author showed in a general way the geographic, topographic and climatic conditions which tend to produce within the limits of the state a very extensive fauna, and showed the presence of components derived from quite unlike faunal regions.

'Conditions Affecting the Distribution of Forest Trees in Nebraska,' Professor C. E. Bessey. A statement of the conditions which have limited the development of forests in Nebraska in the past, evidences showing the existence of suitable conditions for the future spread of forests in the state, and an examination of the conditions which affect, favorably or unfavorably, this development.

'Madstones,' Professor H. B. Duncanson. Reference to popular theories held in some portions of the state.

'The Development and Distribution of the Human Warble Fly,' Dr. H. B. Ward (illustrated by lantern). An account of several specimens recently secured from Central America.

'A Method for the Study of Peripheral Nerves,' Mr. W. A. Willard (illustrated).

'On the Development of the Pineal Eye of Lizards,' Mr. Willard (illustrated).

Many important items of business were transacted, the most important being measures taken to insure the regular appearance in the future of the *Proceedings* of the society and the limiting of its scope to articles strictly the results of original investigation.

The following officers were elected:

President—Professor Lawrence Bruner, University of Nebraska.

Vice-President—Mr. Wm. Cleburne, Omaha, Nebr.

Secretary—Dr. Robert H. Wolcott, University of Nebraska.

Treasurer—Mr. Geo. A. Loveland, United States Weather Service, Lincoln, Nebr.

Board of Directors—Mr. Charles Lobingier, Omaha, Nebr.; Dr. A. S. Von Mansfelde, Ashland, Nebr.; Professor H. B. Duncanson, State Normal, Peru, Nebr.

Somewhat over forty members and many visitors were in attendance and the meeting resulted most successfully.

ROBERT H. WOLCOTT,
Secretary.

NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

THE regular meeting of the section was held March 23, Professor Thorndike presiding. The first paper was presented by Dr. Clark Wissler, 'Observations on Abnormalities of the Hard Palate.' The paper reported progress in the measurements of the casts of the hard palates of idiots. The first thing to be considered in this work was the determination of the significant points and dimensions in the palate. The results presented indicated important structural relations between the width at the canine teeth and the length of the palate measured from the first molars and the maximum height of the arch. The comparative study of the palates of normal and of idiotic persons will be based upon these measurements.

Dr. A. Hrdlicka then read a paper, 'Physical Anthropology of the Hyde Expedition in 1902.' During 1902 Dr. Hrdlicka made two expeditions, one of seven and the other of three months' duration, to the southwestern United States and Mexico. These expeditions were the conclusive ones of a series of five, begun in 1898, made for the purpose of ascertaining the physical characteristics of all those present as well as extinct tribes which occupy or occupied the region marked by the boundaries of the ancient Pueblos, Cliff-

Dwellers and Nahuan (Toltec, Chichimec, Aztec) peoples. The region thus bounded extends uninterruptedly from Utah and Colorado to the Mexican states of Morelos and Guerrero, and in it live at present a little over forty tribes or distinct groups of Indians. About nine tenths of all these peoples were visited on the five expeditions and examined; all the measurements and data secured are being studied, but to arrive at detailed results will require several years.

What can now be safely stated is: (1) All the ancient as well as the modern peoples in the region mentioned belong to three physical types, and these types are identical with those widely represented in all directions outside of this region; and (2) a very large majority of the present peoples examined are physically identical with the prehistoric inhabitants of these same districts (so far as could be ascertained from the osteological material recovered); the prehistoric remains (osteological) show no type that is not represented somewhere in the region covered to-day, and there is no type among the living tribes not represented among the ancient ones.

The visit of so large a number of tribes, as well as the search for skeletal remnants of the extinct peoples, afforded a very good opportunity for general ethnological and archeological observations, the substance of which can be stated as follows: The Mexican Indians visited, with the exception of the Huichols and Tarahumares, are in their mode of life and habits far more like the whites about them than is the case with our Indians of the southwest; nevertheless, the Mexican tribes preserve much that would be of value to the ethnologist. Dr. Hrdlicka's exploration in northern Jalisco and in Zacatecas resulted in the discovery of the ruins of eleven good-sized pueblos or towns, the excavations at one of which showed that its inhabitants had reached a comparatively high grade of culture. The pueblo and cliff ruins of our southwest may be compared to a head which connects by a long narrow neck running through Cora Grande in Arizona, Coras Grande in Mexico, Zape in Mexico and La Quemada in Zacatecas, with a large body of ruins which begin in southern Zacatecas and Jalisco and extend through all the southern part of Mexico to Guatemala and Central America. La Quemada was found to be above all a fort, in all probability the most representative stone-built native fort in North America.

In Zacatecas Dr. Hrdlicka discovered a colony of Tlascaltecs, transplanted hither by the Spaniards in the seventeenth and eighteenth centuries; and further south he found two villages still occupied by the remnants of the ancient Chichimecs of Teul. South of Juchipilla, in Zacatecas, is located a perfect cliff-dwelling, probably the most southern one in existence. This particular ruin, known under the name of 'Las Ventanas' (the windows), has been visited by at least one American before, namely, by Miss Britton.

James E. Lough,
Secretary.

NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

At the meeting of the section on March 2, Professor Wm. Hallock read a paper on the 'Measurement of the Altitude of Mount Whitney, California, by Boiling-point Determinations.'

At the time of the ascent of Mount Whitney last summer by the party under Mr. Harrington Putnam, apparatus was taken to the top, and a determination of the boiling point was made at ten o'clock on August 23. The observed boiling point was 186°.47. Applying the instrumental corrections and reducing this by the Smithsonian tables, the corresponding barometric pressure was 17.70 inches. The Weather Bureau kindly furnished the barometric pressure, temperature and vapor tension for Independence, California, for that morning. They were: barometric pressure, 25.93 inches; temperature, 78°.0, vapor tension, 0.110 feet. Substituting these values in the formula given by Bigelow on page 490 of the second volume of the annual report of the 'Chief of the Weather Bureau' for 1898–99, a difference in altitude between Independence and Mount Whitney of 10,633 feet results. Inasmuch as this determination was made five feet below

the actual summit of the mountain, and Independence is 3,910 feet above sea-level, it would give a final value for the elevation of Mount Whitney of 14,548 feet. It may be stated in this connection that the value which was obtained by Secretary Langley as a result of a very complete series of determinations was 14,522 feet. Of course, this coincidence is accidental, as the probable error in either case is undoubtedly not less than ten or fifteen feet. One object of this determination was to show the availability of boiling-point apparatus, which is light and convenient for such determinations, as being very much more reliable than the aneroid barometer, and much easier for transportation than the mercurial barometer.

A second paper was read by Dr. S. A. Mitchell, on 'The Discovery of New Gases in the Sun,' in course of which it was shown that the interdependence of the sciences is nowhere better illustrated than in spectroscopic work, when astronomy, the most ancient of all the sciences, goes hand in hand with physics to find a new chemical element. In recent years, through spectroscopic researches, several metals have been added to the list of elements. In April, 1895, by investigations on a specimen of clevite, Ramsay announced the discovery of terrestrial helium which gives a line in its spectrum agreeing with the D_3 line, familiar for more than twenty-five years in stellar, prominence and chromospheric spectra. About the same time, Rayleigh and Ramsay announced the discovery of another new element which was called argon. In the early summer of 1898, Ramsay found two more gaseous elements, neon and krypton, and subsequently a heavier gas to which the name xenon was applied. These five new elements, helium, neon, argon, krypton and xenon are found in atmospheric air, and can be obtained from air by fractional distillation by making use of the extremely low temperatures of liquid air and liquid hydrogen. Atomic weights have been assigned as follows: helium, 4; neon, 20; argon, 40; krypton, 82, and xenon, 128; and the gases seem to form a series in the periodic table of elements between the fluorine and sodium groups.

Investigations carried out on photographs of the 'flash' spectrum at the Sumatra eclipse of 1901 enabled Dr. Mitchell to find that the remarkable variations in the intensities of the lines of the ordinary solar spectrum and of the 'flash' spectrum (for one does not *look* to be the reversal of the other) are due to the different *heights* to which the vapors of the various metals ascend above the sun's surface. As a consequence, although helium lines are not found in the ordinary solar spectrum, the helium lines in the spectrum of the chromosphere are very bright, indeed.

In view of the similarity of the new gases, neon, argon, etc., to helium, and as the helium lines are such prominent ones in eclipse spectra, it was expected that the new atmospheric gases—at least the lighter ones, neon and argon—might appear in the sun's atmosphere. A detailed comparison of the lines of the flash spectrum measured by Dr. Mitchell with those of the new gases lately published has led to the discovery that neon and argon are both present in the chromosphere, while it is doubtful whether krypton and xenon are there or not.

S. A. MITCHELL,
Secretary of Section.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

March 6.—Dr. Julien showed some very large chlorite pseudomorphs after garnet from the Spurr mine, Marquette, Mich., a single crystal measuring almost four inches in diameter. Professor Grabau reviewed Dr. A. E. Ortmann's paper on 'The Geographical Distribution of Fresh-water Decapods and its Bearing upon Ancient Geography.'

March 13.—Dr. A. F. Rogers discussed crystal habit and methods of expressing it. Dr. Julien reviewed a paper by M. J. Fuller in the *Journal of Geology* (November–December, 1902) on the etching of quartz in the interior of conglomerates. Professor Grabau reviewed from the *American Journal of Science* (August, 1902) a paper by W. M. Davis on the terraces of Westfield River of Massachusetts.

March 20.—The following papers were reviewed: Charles Schuchert, 'On the Manlius

Formation of New York' (*American Geologist*, March, 1903); B. E. Livingston, 'The Distribution of the Plant Societies of Kent County, Mich. (Mich. Surv., 1901), by Professor Grabau. Stuart Weller, 'The Composition, Origin and Relationships of the Corniferous Fauna in the Appalachian Province of North America' (*Journal of Geology*, May–June, 1902); G. F. Matthew, 'Notes on Cambrian Faunas' (*Trans. Roy. Soc. Can.*, 1902–03), by Miss Florence Henry.

H. W. Shimer.

NEW YORK SOCIETY OF BIOLOGY TEACHERS.

The third meeting of the academic year was held Friday, January 30, 1903, at 8:15 P.M.

The topic for the evening's discussion was 'The Public Scientific Institutions and the School System.' Dr. H. C. Bumpus, of the American Museum of Natural History, opened the discussion. He said, in part, that certain of the collections had been directly planned with a view to helping teachers and students, that rooms and a working library had been set apart for their use, and that sets of guide leaflets had been issued for the express purpose of making the collections more directly available to the teaching public. He then indicated how certain exhibits might be arranged to cover a number of special subjects, and especially to bring the museum into use as a factor of public instruction in matters of current interest.

Dr. N. L. Britton then explained in detail to what extent the New York Botanical Gardens were available to teachers and students. Especially with reference to the trips under guidance of a detailed official, the permanent microscopic exhibit, the arboretum, the museum and public lectures, the garden was of practical assistance to the teacher. It was hoped later to furnish some plant material free to the board of education.

Dr. C. H. Townsend called attention to the fact that the New York Aquarium was already cooperating with the high schools of the city to the extent of setting aside material and balanced salt-water aquaria for them, and in closing the aquarium to the public for two days in the week to allow classes from the schools to work in quiet. He furthermore offered to supply the schools with invertebrate material as needed in cooperation with the board of education.

Dr. A. G. Mayer pointed out some practical examples of what was being done by the Brooklyn Institute of Arts and Sciences for the schools, and gave his ideals of a children's museum which should be incorporated in the museum.

After the regular program a general discussion followed, with this practical result: A committee was appointed by the president of the association to endeavor to obtain, so far as possible, the fullest cooperation between the public scientific institutions and the city schools.

The following officers were elected to hold office for 1903:

President—H. A. Kelly, Ethical Culture School.

Vice-President—Miss K. B. Hixon, Morris High School.

Secretary—G. W. Hunter, Jr., DeWitt Clinton High School.

Treasurer—Miss I. M. Clennedin, Girls' High School, Brooklyn.

G. W. Hunter, Jr.,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE TYPES OF LINNÆAN GENERA.

The interesting note of Mr. O. F. Cook, on the 'Types of Pre-Linnæan Genera' (Science, February 27, 1903, p. 350), touches the most important question still unsettled in the nomenclature of animals and plants. We have yet to agree on a means of fixing the type for the genera of the earlier writers, our conception of a genus being necessarily that of a cluster of species grouped around the type species of a genus. The fixation of type by elimination is an utter failure, as Mr. Cook has pointed out. It is impossible to define this process so as to bring out the same result in different hands and in different groups.

We have already recognized that the selection of names must not in any degree be left to individual choice. We must agree that the choice of the type of the genus must be made

with sole reference to the author in question and his sources of knowledge, and that the operations of subsequent writers are not to be considered. In choosing types for Linnæan genera, we must settle the matter with Linnæus himself, considering only his purpose, the knowledge he possessed and the sources whence he drew his information.

We have rarely any difficulty in indicating the species Linnæus would have chosen had he adopted the idea of type. To a certain extent he did recognize this idea, and he tells us that in each genus his type 'is the best known European or officinal species.' When he took his genera from Tournefort or Artedi, he presumably took the idea of type also, and to find this we may well look back to these earlier and greater naturalists.

In Linnæus's arrangement, the type was usually placed in the middle of the genus, for he was developing a system of catalogue and record. But nearly all subsequent authors have, under each genus, spoken first of the species they knew best, that which we should call the 'type.' Cuvier and his followers place as the 'chef de file' the type species or best-known form, describing it fully, letting the other species follow with shorter or comparative descriptions. Various authors have chosen Linnæan specific names for their genera, the species thus honored being clearly recognizable as the 'type.'

We may adopt as fair some such rule as this: The species first named under the description of a genus shall be regarded as its type unless, as with Linnæus, the context shows that some other species was or would have been chosen by the author, or unless the name of the genus is drawn from a Linnæan or other early specific name.

To take the first species in all cases, not even excepting the case of Linnæus, would have distinct advantages over the present lack of system or over the confusion arising from the method of elimination or from any other device which throws the responsibility on subsequent usage.

David Starr Jordan.

RIDGWAY'S CLASSIFICATION OF THE FALCONIFORMES.

Nothing could be more gratifying to the advanced ornithologist than the vindication of Mr. Robert Ridgway's excellent classification of the diurnal birds of prey through the recent independent researches of foreign investigators.

However, when Mr. Ridgway seems to think that his arrangement, published 1873–76, 'so radically different from any other, found little favor among ornithologists and has generally become forgotten' (see Science, N. S., XVII., March 27, 1903, p. 510), he has evidently overlooked the fact that its essential points have been adopted by practically *all* his American colleagues.

The American Ornithologists' Union committee on classification and nomenclature in the spring of 1885, when preparing the now celebrated A. O. U. check-list of North American birds, had to decide what classification to follow. The present writer had then recently promulgated a new system of the entire class of birds, and several of the members were in favor of its adoption without modification. The majority, however, believed this to be a too radical departure from the then accepted standards to be palatable to the large number of amateur ornithologists forming the bulk of the A. O. U. membership. On the other hand, it was admitted that the Sundevall-Lilljeborg system then in vogue had become too antiquated to serve without serious changes. The writer, who was present by invitation as a consulting member without vote, was then requested to frame a compromise scheme which would eliminate some of the worst features of the old system without deviating too violently from it. The result was the classification still adhered to in the A. O. U. check-list.

The arrangement of the birds of prey in that list is briefly as follows:

Order RAPTORES. Birds of Prey.
Suborder SARCORAMPHI. American Vultures.
Family Cathartidæ. American Vultures.
Suborder FALCONES. [Old World] Vultures, Falcons, Hawks, Buzzards, Eagles, Kites, Harriers, etc.

Family FALCONIDÆ. Vultures, Falcons, Hawks, Eagles, etc.
Subfamily *Accipitrinæ.* Kites, Buzzards, Hawks, Goshawks, Eagles, etc.
Subfamily *Falconinæ.* Falcons [including the Caracaras].
Subfamily *Pandioninæ.* Ospreys.

It will be seen that this scheme of 1885 is essentially that of Ridgway (1873–76), the only difference being that *Pandion* was given a somewhat more independent position, easily explained by the fact that the whole, as shown above, was to some extent a measure of compromise. The Accipitrinæ are otherwise identical with Ridgway's Buteoninæ containing, as they do, the Old World vultures, the eagles, kites, buzzards, etc.

I must, therefore, claim for the American ornithologists the honor of having appreciated and followed Ridgway's classification of the Falconiformes for eighteen years.

The Old World ornithologists, as a whole, it is true, have been lagging behind. Yet, there are noteworthy exceptions. Thus, I would call attention to a very important paper by Mr. P. Suschkin in the *Zoologischer Anzeiger* for 1899 ('Beitraege zur Classification der Tagraubvoegel mit Zugrundelegung der osteologischen Merkmale,' *Zool. Anz.*, 1899, pp. 500–518), in which he, three years before Pycraft's work, commends and adopts all the essential features of Ridgway's scheme which his own investigations on forty-four genera corroborate, elaborate and partly correct.

LEONHARD STEJNEGER.

U. S. NATIONAL MUSEUM,
March 28, 1903.

HOTEL HEADQUARTERS OF THE AMERICAN ASSOCIATION.

TO THE EDITOR OF SCIENCE: While traveling homeward after the recent meeting of the scientific association I spent some time, which would otherwise have been hanging heavily on my hands, in studying out a few of the relations indicated by the registered list of attendance. This list included 972 names, a number somewhat less than the total registration, but the difference is not great enough to have any important effect on results.

The question for solution was this: "What is the meaning of 'hotel headquarters'?"

It has been the custom for a dozen years past to designate some hotel as headquarters. This hotel has been conveniently near to the places of meeting of the sections, and in it the council of the association held their meetings. A majority of the council usually secured their rooms at headquarters, and it was generally understood that the social advantage implied in taking up one's temporary abode with a majority of the most prominent members present was more than an offset for the expense of accommodation at a fashionable hotel. This item of expense is one that is unfortunately more important to most followers of pure science than to the captains of industry who reap the benefits of applied science and 'legislative favors.' The hotels have, until recently, been disposed to make such reduction in rates as to constitute an inducement to make hotel headquarters the real headquarters of the association.

To the rule just named there have been a few conspicuous exceptions, as at the Buffalo meeting in 1896 and the Pittsburgh meeting in 1902. Every hotel proprietor has a perfect right to offer or refuse reduction of rates; but it is at least desirable that such hotel be chosen as to make it reasonably probable that a large percentage of members will find it advantageous to select the same gathering-place.

Of the 972 persons whose names were included in the Washington list under examination 352 were residents of Washington, and hence a trifle over 36 per cent. of those registered are naturally excluded from the body of temporary residents at hotels. The attendance at the largest five hotels is given in the following table, where the 'hotel headquarters' leads the list.

Arlington	55,	or	5.7 per cent.
Ebbitt	134,	"	13.8 " "
New Willard	27,	"	2.8 " "
Raleigh	24,	"	2.5 " "
Oxford	21,	"	2.2 " "
	261		27.0

This shows that more than two thirds of those present at the Washington meeting avoided the larger hotels. But what is most noticeable is that there were only about two fifths as many registered at headquarters as at another hotel. The meetings of the council were not held there, and not more that half a dozen members of the council made it their stopping place. More than one person who had gone to headquarters in the hope of meeting friends soon went elsewhere. The announcement in the preliminary circular that the Arlington would be headquarters proved to be unfortunate. At Pittsburgh last summer local conditions caused 165 out of the 431 persons present, or about 38 per cent., to meet the high charges imposed at headquarters.

This statement of facts must not be interpreted as an implied criticism upon the management of the local committee at Washington. The permanent secretary has been so systematic, energetic and courteous, that it would be hard to find any reasonable ground for criticism. All that is intended is to call attention to the fact that, under the conditions that appear now to exist, the custom of specifying any place as headquarters seems one 'more honored in the breach that the observance.'

W. Le Conte Stevens.

Lexington, Va.,
January 14, 1903.

PROCEEDINGS OF THE AMERICAN ASSOCIATION.

To the Editor of Science: In your issue of March 13 W. J. Beal makes a plea for the publication in full of all the papers read at the meetings of the American Association for the Advancement of Science in the *Proceedings* of the Association. I must enter a protest against this. I should be entirely unwilling to have my recent paper on 'Abelian Functions and their Relation to the Specific Gravity of Sirius' buried in the *Proceedings,* where it would never meet the gaze of most of my astro-mathematical friends. Nor do I care to wade through dozens of pages about the 'Stero-isomerism of Azonium Derivatives,' and the 'Ecology of the Dominican Thelophoraceæ' in order to find a few pages of interest to me on skew helicoids.

No, the *Proceedings* should contain merely the titles of the papers read, with a reference to where the original is to be published; a brief abstract of every paper should appear in Science; but the papers in full should be published only in the special journals where they belong and where they will meet the eyes of those, and those alone, who are particularly interested in them. Of course there are some papers read in the sections which are of more than technical interest. For such the columns of Science are the fitting place, for here they will reach the eye of every member of the association.

X.

SHORTER ARTICLES.

ADDITIONAL SPECIMENS OF THE JAPANESE SHARK, MITSUKURINA.

In a recent number of the *Japan Daily Advertiser* (Yokohama, March 4, 1903, page 5) there is a notice, and it deserves record in Science, of the capture of additional specimens of the deep water shark, *Mitsukurina.*

Students of fishes will recall that in 1898 Dean Mitsukuri, on the occasion of his visit to Washington as a delegate to the International Fur Seal Conference, brought with him a shark which caused considerable comment. This specimen had been taken in deep water off the Bay of Tokyo; then it came into the hands of Mr. Alan Owston, a resident naturalist of Yokohama, and by him it had been presented to the Imperial University of Tokyo. A detailed account of this new shark soon appeared in the *Proceedings of the California Academy of Sciences,* Ser. 3 Zoology, Vol I., pp. 199–204, 1898, and it was here described by President Jordan as *Mitsukurina owstoni,* and regarded as the type of a distinct family of lamoid sharks. The most prominent features of the new form were the elongated and spatulate snout, the great extent of the ventral lobe of the tail and a general looseness of make-up, notably in its protractile and expansible jaws. The form was evidently from deep water, and structurally it seemed to be a close ally of *Odontaspis,* so close, indeed, that we are still in doubt whether

Dr. Jordan was justified in regarding it as representing a distinct family. Of general interest the specimen certainly was, however, from its grotesque appearance. But the feature which gave it especial value to the student was its resemblance to a shark of the Cretaceous period, *Scaphanorhynchus*, generally assumed to be extinct. Was it possible, then, that this Cretaceous shark was still living in Japanese waters? And if this were true, might it not occur in other deep-sea regions, like its more ancient relative, *Chlamydoselachus?* Thus we find that Dr. Arthur Smith Woodward, of the British Museum, commenting (1899) upon *Mitsukurina*, is distinctly of the opinion that the new genus was but a synonym for the Cretaceous shark, and he gives the evidence in favor of this view in the *Annals and Magazine of Natural History* (7), Vol. III., pp. 487–489, and makes out a fairly convincing case of identity. Nevertheless, we have to admit that the characters of the fossil shark are as yet too imperfectly known to warrant a definite judgment, and the safer course, therefore, is to acknowledge for the present the validity of the name *Mitsukurina*.

The note in the Japanese paper announces that more specimens of this shark have been taken, and we have promise, accordingly, that better anatomical data may be looked for. For one thing it now appears that the specimen first studied was an immature one, no examination of the soft parts having been made. The latest specimen in the hands of Mr. Owston measures, *mirabile dictu*, about twelve feet in length and its weight is estimated as between four and five hundred pounds. This extreme size, it will at once be seen, ranks this shark as one of the largest members of deep-water ichthyic fauna, and it is possibly the most formidable member of its community.

The depth at which the specimen was taken is not stated, but from the conditions of fishing near Numazu, the fish was apparently taken in water deeper than three hundred fathoms. As a symptom of its living at a great depth one notes in the latest description of the fish, that its 'flesh and skeleton are extremely limp, folding like a wet rag.' The color of the fresh specimen is described as 'light reddish-brown, the fins darker brown; nuchal region a little darker, and belly paler.'

BASHFORD DEAN.

EARLY INSTANCE OF TANGIBLE LIP-READING.

AN interesting feature of the autobiography of Miss Helen Keller is the account by her teacher, Miss Sullivan, of her patient efforts to train her young pupil to receive and communicate ideas by tangible lip-reading. Most persons regard the education of blind deaf-mutes as a development of modern philanthropy, and it will surprise many to learn that the method of tangible lip-reading was invented nearly two hundred and thirty years ago.

Bishop Burnet, the famous English historian and theologian, in a letter dated Rome, December 8, 1685, and addressed to the eminent scientist Hon. Robert Boyle, wrote as follows:

There is a minister of St. Gervais—Mr. Gody — who hath a daughter that is now sixteen years old. At a year old the child spoke all those little words that children begin usually to learn at that age, but she made no progress; yet this was not observed till it was too late, and as she grew to be two years old they perceived then that she had lost her hearing, and was so deaf that ever since though she hears great noises yet she hears nothing that one can speak to her. But the child hath by observing the motions of the mouths and lips of others acquired so many words that out of these she has formed a sort of jargon in which she can hold conversations whole days with those that can speak her own language. I could understand some of her words but I could not comprehend a period [sentence]; for it seemed to me a confused noise. She knows nothing that is said to her unless she seeth the motion of the mouths that speak to her, so that in the night when it is necessary to speak to her they must light a candle.

Only one thing appeared the strangest part of the whole narrative. She hath a sister with whom she has practiced her language more than with any other; and in the night, by laying her hand on her sister's mouth she can perceive by that what she says and so can discourse with her in the night. It is true her mother told me this

did not last long, and that she found out only some short period in this manner, but it did not hold out very long. Thus this young woman hath merely by a natural sagacity found out a method of holding discourse that doth in a great measure lessen the misery of her deafness. I examined this matter critically, but only the sister was not present, so that I could not see how the conversation passed between them in the dark.

The bishop's language will be clearer if we replace his word 'period' by the word 'sentence.' This passage occurs in a volume entitled 'Some Letters Containing an Account [of travels] in Switzerland, Italy [and] Germany in 1685 and 1686,' by Gilbert Burnet, London, 1687 (another edition, 1724), 1 Vol., 8vo.

HENRY CARRINGTON BOLTON.

MARY LOUISE DUNCAN PUTNAM.

MRS. PUTNAM is dead. To those of us who saw her recently, active and happy, the news comes as a shock. But, for her, the end was beautiful; in the midst of her life interests, without shrinking or suffering, at the close of a day of work, she lay down to rest.

Mary Louise Duncan was born at Greencastle, Pa., September 23, 1832. Her father, Joseph Duncan, was, at the time, the only Congressman from Illinois, with his home at Jacksonville. Later he was Governor of Illinois and was influential in shaping the trend of affairs in what was then the Far West. On her mother's side also Miss Duncan was of distinguished ancestry, being the great-granddaughter of that brave woman, Hannah Caldwell, of Revolutionary fame. In her father's home and at Washington, Miss Duncan enjoyed every opportunity and came into contact with men and women who planned and carried out great enterprises. In 1854 she married Charles E. Putnam, of Saratoga Springs, New York, and the young couple at once removed to Davenport, Iowa, which was, from that time on, their home. Mr. Putnam was a man of brilliant mind and talent, who, as a lawyer, soon won name, fame and influence in the new home.

Through her life Mrs. Putnam was actively interested in every good work. Her connection with many public and private enterprises deserves mention. But for us her relation to the Davenport Academy of Sciences is of chief importance. Mrs. Putnam was the mother of eleven children; she was devoted to the interests of each and all; with keen sympathy she entered into every child plan of work or play—the garden, the printing press, the family newspaper, the home dramatic performances. In every device of her children she found some helpful stimulus. She was more than an ordinary mother; she was the companion and confidant of each of her flock. So when her oldest child, a boy of fourteen, longed to join the newly founded Academy of Sciences, he demanded that the sharer of his joys, his mother, should also join. She was the first woman member. Joseph Duncan Putnam was a remarkable boy. At fifteen he was the secretary of the academy; before he was a man in years he was known by all the leaders in entomology; at twenty-five he was a recognized authority on some of the least known groups of insects; at twenty-six he died. His ideals for the academy, to which he was absolutely devoted, were high. He urged permanence—a building, a publication, an exchange and contact with the outside world of science. He lived long enough to see the building and to know that the printed *Proceedings* of the academy were prized at home and abroad. In all his work and plans his mother stood ever near. When money was necessary she canvassed the city; when people would not give, she planned and carried out public meetings, lectures, entertainments; in some way, in spite of discouragement and rebuff, she won the day.

And when her son died she devoted herself to rearing his perpetual monument, in the academy. Through dark years, which would have daunted all but a mother's love, she has toiled, and she has succeeded. The academy lives and will live. Through her interest a publication fund, memorial to her son and her husband, was secured, and the *Proceedings* have been continuously published. The volumes contain important contributions in all fields, but prominent among them are those

in entomology, by masters who had known and loved young Putnam. Mrs. Putnam, convinced of future development, insisted on securing for the academy additional land and a church property, which, rechristened as *Science Hall,* now houses part of the museum collections and supplies an audience room for public gatherings and scientific lectures. Through her urgency a year ago, a curator was called that more and aggressive work might be undertaken. To-day the Davenport Academy of Sciences has its valuable land, two buildings, important collections, eight volumes of published *Proceedings,* endowed publication fund, small but growing general endowment, an active and competent curator, because *she* has rallied the little band of workers through dark days and has encouraged them when they might falter.

Within the last two years the academy has undertaken much new work. Its desire is to come into a close and helpful relation with the general work of education of the city. Before the new curator, Mr. Paarmann, was called, Miss Sheldon, the corresponding secretary, reestablished the long discontinued lectures to school children at the academy's museum. Since the arrival of the curator, Mr. Paarmann and Miss Sheldon have continued this important work, with gratifying success. In this work Mrs. Putnam was greatly interested and heartily sympathetic. She was enthusiastic also in establishing courses of scientific lectures. The first of these was given in the winter of 1901–02; the second was presented during the season just closing. They were well received and proved more than self-supporting. With delight, Mrs. Putnam, as president of the academy, watched the development of work, the growth of plans, the increasing interest of the community. In February, after the lecture course was closed, she turned her attention to an exhibition of Indian basketry, to be arranged at the academy, for its benefit. All preparations were completed, and on February 19 the doors were opened. The exhibition was to continue through three days and its success was ardently desired. Unexpected numbers came the first and second days and went away delighted. On the night of the 20th, after a busy and happy day at the exhibition, pleased and satisfied at the result and looking forward to an even better morrow, Mrs. Putnam went to her home. A little wearied, she lay down to rest; without a word, and probably without suffering, she passed away.

Mrs. Putnam made no pretensions to be a scientist. But she knew almost every prominent scientific worker in our country and many of the foreign students. She loved to attend the gatherings of the American Association and other organizations, that the academy might keep in touch with the world of science. In October last she was in attendance at the Congress of Americanists in New York. Though she was not present, the American Association for the Advancement of Science, in its December meeting at Washington, elected her a fellow. This unsolicited mark of esteem greatly pleased her, though she felt herself undeserving of it. To whom, however, could it have been more worthily given than to her who had striven so loyally for the advancement of science?

In her death, the object of so much love and labor was not forgotten. The whole of her estate is left for the academy's benefit. Through the provisions of her will \$24,000 are available for the continuance of publication of its volumes of *Proceedings.* The academy will continue to touch the outside world of science. Thus, though dead, they speak—the mother and the son, once more united.

Frederick Starr.

THE ROYAL GEOGRAPHICAL SOCIETY.

We learn from the London *Times* that the society will this year make its awards as follows: The Founder's medal has been awarded to Mr. Douglas W. Freshfield for his explorations in the Caucasus and the Himalaya, and for his persistent efforts to further the spread and raise the standard of geographical education. In 1868 he made a journey to the central Caucasus which included the first ascents of Kasbek and the eastern summit of Elbruz and the discovery of new snow passes across

the main chain, besides yielding valuable information as to the topography and glaciation of the region. In 1887 and 1889 Mr. Freshfield undertook further journeys to the Caucasus, which added very largely to accurate knowledge of the central group, to the physical geography of the main chain, and to the correct delineation of the higher region, which previously had been but imperfectly mapped. A journey from the headwaters of the Ingur through Abkhasia to Sukhum Kaleh also deserves mention. The two volumes in which Mr. Freshfield has published an account of these travels, 'Central Caucasus and Bashan,' 1869, and 'Exploration of the Caucasus,' 1896, are standard works on the region with which they deal, and contain excellent maps, the fine map of the Caucasus, embodying much new work, being especially noteworthy. In 1899 Mr. Freshfield broke new ground, carrying out an expedition into Sikhim and Nepal, where he made the circuit of Kanchinjunga at a high level, one of the passes being of the height of 20,000 feet. This journey, though interfered with by an exceptional snowfall, yielded valuable results as regards the glaciation and the physical geography of the district.

The recipient of the other royal medal, which is bestowed annually by the patron, is Captain Otto Sverdrup, the leader of the admirably organized and conducted expedition in the *Fram*, extending over a period of four years, which has done so much to complete our knowledge of the geography of the Arctic regions. The expedition was the first to penetrate through Jones Sound to the Arctic seas beyond. It explored the western shores of Ellesmere Land, defining the main outlines of its intricate system of fiords and reaching from the south to a point within sixty miles of that reached by Aldrich on his journey round the north coast. To the west of Ellesmere Land three large islands were discovered, extending west to about 106° west longitude; this discovery confirmed the conjecture that land existed to the north of the Parry Islands. Of the Parry Islands the north shores of Findlay's Island and North Devon were explored for the first time. It will be remembered that Captain Sverdrup was captain of the *Fram* during Dr. Nansen's great expedition, and assumed command when Nansen left the ship. He safely worked the *Fram* clear from the ice, after attaining a latitude of 86° north.

The Victoria medal for geographical research had already been awarded as a special medal to Dr. Sven Hedin.

The minor awards of the society have been bestowed by the council as follows: (1) The Murchison grant is awarded to Mr. Isaachsen, a lieutenant in the Norwegian army, who accompanied Captain Sverdrup on his last expedition. He assisted with the astronomical and magnetic observations, and had charge of the cartographical work. He was Captain Sverdrup's right-hand man, and did a great amount of exploring work. He it was who discovered the two most westerly of the three islands the existence of which the expedition made known for the first time. (2) The Gill memorial goes to Mr. Ellsworth Huntington, an American traveler, who carried out a remarkable journey through the Great Cañon of the Euphrates River, during which he made valuable observations in physical geography. (3) The Back grant is bestowed on Dr. W. G. Smith, of Yorkshire College, Leeds, for his investigations into the geographical distribution of vegetation in Yorkshire, embodied in maps and a paper which will shortly be published. (4) The Peek grant is received by Major Burdon, whose name has been mentioned as the probable first resident at Sokoto, in the Northern Nigerian Protectorate. He has presented to the society a number of excellent route maps which he has compiled as the result of his journeys in northern Nigeria.

SCIENTIFIC NOTES AND NEWS.

The spring meeting of the council of the American Association for the Advancement of Science will be held in the Cosmos Club, Washington, D. C., on Thursday, April 23, 1903, at 4:30 P.M.

The annual stated session of the National Academy of Sciences begins at Washington on Tuesday, April 21.

THE Laboratory of the United States Fish Commission at Woods Hole, Mass., will be opened on June 15 for the nineteenth season of its existence. The privileges of the laboratory, including the services of the staff of collectors and use of the commission's fleet of vessels, are as usual extended free of charge to those competent to carry on research in marine biology. Applications for tables should be sent to the director of the laboratory, Dr. F. B. Sumner, 17 Lexington Ave., New York City.

MR. OTTO H. TITTMANN, superintendent of the U. S. Coast and Geodetic Survey, has been appointed commissioner for the United States to mark the boundary line between this country and Canada.

THE subject of the Silliman lectures to be given at Yale University by Professor J. J. Thomson, of Cambridge University, will be 'The Present Development of Our Ideas of Electricity.' The lectures, eight in number, will begin May 14.

THE Prince and Princess of Wales, will receive the honorary degrees of Doctor of Laws and Doctor of Music respectively from the University of London on Wednesday evening, June 24.

THE British Academy has elected new fellows increasing the membership from forty-eight to seventy. Among those elected were Professor F. Y. Edgeworth, professor of political economy, Oxford University; Professor B. Bosanquet, professor of moral philosophy, St. Andrew's University; and Dr. G. F. Stout, Wilde reader in mental philosophy, at Oxford University.

DR. FREDERICK C. NEWCOMBE, professor of botany at the University of Michigan, has been elected president of the Michigan Academy of Science.

PROFESSOR W. S. JACKMAN, of the University of Chicago, has been elected president of the Natonal Society for the Scientific Study of Education.

THE Hon. Andrew D. White, recently ambassador to Germany and formerly president of Cornell University, will return to the United States in June and will spend the summer at Ithaca.

DR. WALDEMAR KOCH, assistant in pharmacology, at the University of Chicago, leaves, at the end of the quarter, for six months' work in Schmiedeberg's laboratory in Strassburg. Dr. Koch will also visit the leading physiological and pharmacological laboratories in Europe, including Pawlow's in St. Petersburg.

DR. K. A. EWALD, professor of medicine in the University of Berlin, expects to visit the United States in May.

PROFESSOR H. L. BOLLEY, botanist of the North Dakota Agricultural College and Experiment Station has been appointed special agent for the investigation of the flax crop and flax diseases in Europe. Mr. Bolley will sail the first of June, spend some time in the Netherlands and then proceed to eastern Russia, where an extensive study will be made upon the Russian crop, with a view to procuring types of seed which will be valuable for use in this country. Professor Bolley has lately made some very interesting discoveries concerning the cause of flax-sick soil. He seems to have shown that the reason flax can not be grown continuously on the same ground is due to the presence of a wilt disease caused by a species of Fusarium.

MR. ELLSWORTH HUNTINGTON has lately been appointed research assistant by the Carnegie Institution and will go with Professor Davis to join Professor Pumpelly in Turkestan. Mr. Huntington graduated at Beloit College, Wisconsin, in 1897; he then spent four years as science teacher in Euphrates College, Harput, Turkey, and while there made an adventurous journey through the cañons of the Euphrates, for which he has lately received the Gill memorial from the Royal Geographical Society of London. For the past two years he has been attending the Graduate School of Harvard University, and last summer he was one of Professor Davis's party in Utah and Arizona.

DR. HERBERT S. JENNINGS, assistant professor of zoology at the University of Mich-

igan, has been awarded a grant of $250 by Carnegie Institution.

Mr. Albert P. Morse, curator of the Zoological Museum of Wellesley College, has been appointed a research assistant in the Carnegie Institution. Mr. Morse will undertake a systematic and biological study of the North American *Acrididæ* with especial reference to geographical distribution, dispersal and variation; and will probably spend July and August in field work in the southeastern states.

The New York *Times* states that the administrative board appointed to organize and conduct the international congresses to be held in connection with the World's Fair in St. Louis in 1904, met on March 11 at the eastern offices of the exhibition. There were present President Butler, of Columbia University, chairman; President Harper, University of Chicago; President Jesse, University of Missouri; Dr. Herbert Putnam, Librarian of Congress, and Frederick W. Holls, member of The Hague Tribunal. The board met to consider the report of the committee on the Congress of Arts and Science, which had been in session the two preceding days. The members of the committee met with the board. They are: Professor Simon Newcomb, Washington; Professor Hugo Münsterberg, Harvard University, and Professor Albion W. Small, University of Chicago. Mr. Howard J. Rogers, director of congresses, was also present. There is to be a 'Congress of Arts and Science,' with 128 sections. The board adjourned to meet in St. Louis on April 29.

The Swedish government has appropriated $20,000 for the publication of the scientific results of Dr. Sven Hedin's journey through central Asia. The work will comprise an atlas of two large volumes, while a third volume will contain Dr. Hedin's report on the geography of the country. Further volumes will be devoted to the meteorological observations, the astronomical observations, the geological, botanical and zoological collections, and the Chinese manuscripts and inscriptions. The work will be published in the English language.

Dr. William T. Harris, U. S. Commissioner of Education, will deliver an address on April 25 at the School of Pedagogy, New York University, on 'Education in the United States.' The meeting has been arranged as a memorial to Dean Edward R. Shaw, and a portrait of Dr. Shaw will be presented by the students to the university.

Professor Henry Barker Hill, director of the Chemical Laboratory of Harvard College, died on April 6 in his fifty-fourth year.

Rear-Admiral George E. Belknap, retired, who in addition to eminent services in the navy was in charge of important hydrographic work and was at one time superintendent of the Naval Observatory, died on April 7, at the age of seventy-one years.

Dr. Laborde, an eminent French physician and a member of the Academy of Medicine, died on April 7.

The death is announced of Professor J. G. Wiborgh, of the Stockholm School of Mines, at the age of sixty-four. He was the leading authority on the metallurgy of iron in Sweden and the author of numerous works on the subject.

The daily papers state that the headquarters of the Carnegie Institution, Washington, are about to be removed from the private house at the corner of K and Fifteenth Streets, to a suite of offices in the Bond Building, at the corner of New York Avenue and Fourteenth Street.

A conference to consider the founding of a national seismic association will be held at Strasburg at the end of July.

Four thousand Spanish physicians and fifteen hundred foreigners have already registered for the International Congress of Medicine to be held at Madrid at the end of the present month.

We learn from *Nature* that the officials of the Sanitary Department of the Egyptian Government, into whose hands the expenditure of the recent gift of 40,000*l*. entrusted to Lord Cromer and his successors in office by Sir Ernest Cassel for the relief of ophthalmia and eye diseases has virtually passed, have decided

to employ it in establishing a 'traveling dispensary' in the form of a tent, to suffice for all purposes of operation and treatment, and to work solely in the provinces.

The annual meeting of the general board of the National Physical Laboratory of Great Britain was held on March 20, Lord Rayleigh, the chairman of the board, presiding. According to a notice in the London *Times* the annual report of the executive committee, giving details of the work since the opening of the laboratory, was approved. It appears from the report that subscriptions and donations amounting to nearly £1,000 a year have been promised by the Institution of Civil Engineers, the Iron and Steel Institute, the Institute of Chemical Industry, and various private firms. Efforts are being made to extend the list and more especially to render the laboratory self-supporting by increasing the work done for firms and private individuals. Examples of such work are given in the report and in a lecture to the Students' Association of Mechanical Engineers recently delivered at the Institution of Mechanical Engineers by the director and now being published in *Engineering*. The scheme of work suggested by the director for 1903 was also approved. After the meeting an inspection of the laboratory took place, and in this the board were accompanied by a number of gentlemen who have assisted the laboratory by serving on its various committees, or as donors of apparatus.

Cablegrams are no longer sent giving reports of the plague in India, and the subject has been practically forgotten by the general public. For the last week, however, for which reports are at hand, the deaths numbered 28,860, much more than at any corresponding period of the year since the original outbreak of the plague in 1896.

The 'Annual Report of the Field Operations of the Bureau of Soils' for 1902, containing the results of the soil survey work of the bureau for the calendar year, has just been completed and is now in press. It will not, however, be available for distribution before October next, owing to the length of time necessary to lithograph the accompanying maps. It will be issued in two parts, one containing 44 lithograph soil maps drawn on a scale of one mile to the inch, covering each of the areas surveyed, indicating in colors the location and extent of the various soil types, and in addition, in western areas, the presence and amount of alkali existing. The other part, embracing about 800 pages, illustrated, contains the reports of assistants in charge of surveys. These reports treat each area in detail, and contain valuable data relating to the location and boundaries of the areas, history of settlement and agricultural development, climatic conditions, physiography and geology, descriptions of soil types with origin and process of formation, crops grown and yields, crops to which soils are especially adapted, special soil problems, irrigation and drainage, alkali conditions, agricultural methods in use, cultivation, cropping, and general agricultural and economic conditions. Fifteen soil parties were maintained in the field during the year, and there was surveyed and mapped 17,911 square miles, or 11,463,040 acres, covering thirty-two areas in twenty-five states and territories and in Porto Rico. The area previously surveyed by the bureau was 15,871 square miles, making a total to date of 33,782 square miles, or 21,620,480 acres. The total cost of the work, including transportation, salaries, subsistence, supplies, inspection, preparation of reports, etc., amounts to an average of $2.88 per square mile, or about thirty-three cents per one hundred acres. During the current year the number of soil survey parties has been increased to twenty, which it is expected will make surveys of about fifty areas in thirty-two states and territories.

The London *Times* states that a new association to be called the Ulster Fisheries and Biology Association has been formed in Ireland. The object of the new association is to investigate the flora and fauna of the shores and fresh water loughs of Ulster, with special reference to the fisheries. At a meeting held at the museum, Lord Shaftesbury, who presided, said the association had in view

the organizing and equipment of a marine laboratory for the purpose of carrying out investigations and researches. It was hoped that the work of the new organization would assist to develop the fishing industry. He was glad to say that the Department of Agriculture and Technical Instruction had been approached and had decided to help them. That, he thought, was sufficient to indicate that the new association had useful work before it. Mr. H. H. Smiley, who has subscribed £200 towards the funds of the association, was elected first president. It is proposed to start operations at Larne Harbor, where there will be a small marine laboratory. A naturalist has been appointed, who will furnish reports from time to time in the physical and chemical characteristics of the sea water and make other observations.

Recently the President asked the Commissioner of Fish and Fisheries to have made a comprehensive and thorough investigation of the salmon fisheries of Alaska, and for this purpose Commissioner Bowers has appointed a special Alaska Salmon Commission consisting of the following: President David Starr Jordan, of Stanford University, executive head; Dr. Barton Warren Evermann, ichthyologist of the U. S. Fish Commission; Lieutenant Franklin Swift, U. S. N., commanding officer of the *Albatross;* Cloudsley Rutter, naturalist of the *Albatross;* A. B. Alexander, fishery expert of the *Albatross;* and J. Nelson Wisner, superintendent of fish cultural stations of the U. S. Fish Commission. The steamer *Albatross* has been detailed to this work and will go north early in June. The Alaska salmon fisheries are of very great importance, the output of the canneries last year amounting to 2,631,230 cases (of 48 pounds each) valued at $8,667,673. To secure this pack more than 36,000,000 salmon were utilized. It is doubtful if the waters of Alaska can long withstand such an enormous drain as this, and it is for the purpose of securing information upon such questions as this that the investigations will be made.

The Baltimore *Sun* gives details of the expedition to be sent by the Geographical Society of Baltimore to the Bahama Islands, according to which the staff will number fifty persons, and will leave Baltimore early in June in a specially chartered vessel, fully equipped to serve as the home and laboratory of the party during its absence on the trip. The scientific staff will be divided into departments for the study of insular geology, botany, zoology, medical and hygienic conditions, climatology, physics, commercial geography and history. Dr. George B. Shattuck, who was asked by the directors of the society to organize the expedition, will have charge of the geological work. He will have three assistants. Dr. W. C. Coker, professor of biology in the University of North Carolina, will direct the work in botany. Dr. Barton Blow, curator of fish in the National Museum, will investigate the fish of the seas around the islands. Mr. O. C. Glaser, of the Hopkins department of biology, will study the mollusks and Mr. R. P. Cowles, fellow in biology, the cardita of the island. Dr. O. L. Fassig, of the Baltimore office of the United States Weather Bureau, will superintend the work in climatology. A person not yet named will direct the survey of the commercial possibilities of the islands. Mr. J. M. Wright of the Hopkins historical department will have access to the records of the islands, and will prepare a monographic history of them. Mr. A. H. Baldwin, a Washington artist, will be the official illustrator. To Dr. C. A. Penrose will be given the position of director of the medical staff. This department will look into the sanitary conditions of the islands and will notice the effect of the climate on Americans.

The British Medical Journal summarizes the vital statistics for the year 1902 of the seventy-six large towns dealt with in the Registrar-General's weekly returns. The 452,909 births registered in these towns during last year were equal to an annual rate of 30.0 per 1,000 of their aggregate population, estimated at 14,862,880 persons in the middle of the year. In London the birth-rate was equal to 28.5 per 1,000, while it averaged 31.1 per 1,000 in the seventy-five large provincial towns. The lowest birth-rates in these towns

were 17.1 in Bournemouth, 18.2 in Hastings, 20.8 in Hornsey and in Bury, 21.3 in Halifax, 23.0 in Bradford, and 24.0 in Rochdale; the highest rates were 36.4 in East Ham, 36.5 in South Shields, 36.7 in Gateshead, 37.5 in St. Helens, 37.9 in Wigan, 39.4 in Merthyr Tydfil, and 41.5 in Rhondda. During the period under notice 263,091 deaths were registered in these seventy-six towns, corresponding to an annual rate of 17.4 per 1,000 living. In London the rate of mortality was 17.7 per 1,000, while it averaged 17.6 in the seventy-five other large towns, among which the rates ranged from 8.6 in Hornsey, 10.9 in Hansworth, 11.5 in Walthamstow, 11.6 in King's Norton, 11.9 in East Ham and in Leyton, and 12.4 in Bournemouth to 20.0 in Hanley, in St. Helens and in Manchester, 20.2 in Middlesbrough, 20.6 in Wigan, 22.5 in Liverpool, and 23.1 in Merthyr Tydfil. The 263,091 deaths from all causes registered in these seventy-six towns last year included 32,021 which were referred to the principal infectious diseases; of these, 1,764 resulted from small-pox, 7,441 from measles, 2,870 from scarlet fever, 3,924 from diphtheria, 5,578 from whooping-cough, 2,336 from 'fever' (principally enteric), and 8,108 from diarrhea. The death-rate from these diseases averaged 2.12 per 1,000 in the seventy-six large towns.

THE efforts of the hydrographic branch of the United States Geological Survey are being directed to the discovery of sufficient water to lead to the reclamation and habitation of that area of the Great Plains lying west of the prairies and east of the Rocky Mountains, commonly known as the High Plains. The section is admirably suited to agriculture and grazing except for its inadequate water supply, which is so uncertain that great areas of fertile land lie quite uninhabited. This is especially true of the regions lying between the river valleys which cross it at wide intervals. These broad intervalley plateaus are practically waterless, but it has been discovered that water may be had from underground sources by wells and windmills, and it has been demonstrated that, while the region may not be largely reclaimable by irrigation, it may be successfully used for grazing by creating stock-watering points at comparatively close intervals. It will, however, be difficult, if not impossible, for the grazers to raise anything besides fodder cane of the drought-resisting varieties, such as Kaffir corn. Vegetables and other products will, for the most part, probably have to be grown elsewhere. The river valleys, on the other hand, seem destined to be extensively cultivated by irrigation, the water for which will be pumped from the gravels of the river beds, where an underflow has been known to continue in the summer season after the rivers themselves have ceased to run. These areas will furnish garden produce for the ranches on the plateau, and in this manner make the region as a whole habitable. The details of this investigation, with exhaustive studies of the nature of the underground waters of the High Plains, appear in the Twenty-first and Twenty-second Annual Reports of the United States Geological Survey, the latter of which is now in press and will soon be issued.

UNIVERSITY AND EDUCATIONAL NEWS.

ON April 1 Governor Peabody signed a bill giving to the University of Colorado two fifths of a mill annually on the taxable property of the state. This assures an income for the present of $140,000 per annum, with an automatic increase depending on the growth in wealth of the state. The university has now enrolled about 550 students.

MR. ANDREW CARNEGIE has offered to pay the expenses of the students of Cornell University, who suffered from typhoid fever during the recent epidemic at Ithaca.

MRS. VAIL, wife of Professor Vail, has given Hobart College $5,000 to establish a fund to be known as the Charles Delamater Vail library fund.

THREE scholarships of $200, $150 and $125 are announced for the Harvard summer geological course in Colorado under Mr. C. H. White. These scholarships are open to general application from teachers and students of geology, whether now enrolled at Harvard University or not. Applications should be addressed to Mr. White, at the Rotch Build-

ing, Cambridge, Mass., and should state the applicant's previous training in geology and his purpose in further study. Letters of recommendation should be enclosed. Action on applications will be taken about June 1. The expenses of the course, including fee for instruction, will be about $200 from Chicago and return.

The class in geology and mining of the Missouri School of Mines and Metallurgy will make a summer excursion this year, in charge of Director George E. Ladd, to the Black Hills, Butte and Anaconda and the Yellowstone Park. Similar excursions will in the future be a required part of the work at this institution. The new catalogue of this school announces that there will be made, during the spring and summer months, as a part of regular courses, excursions to the Joplin mining district for mine surveying; to the Gasconad River for field practice in lines of communication; to southeast Missouri for geological field work; and to Joplin, St. Louis, Herculaneum and the Flat River district for the study of mines and ore-dressing and metallurgical plants.

The report prepared by the business committee of the general council of the University of Glasgow in response to a statement drawn up at the request of the Carnegie trustees by the University Court and setting forth what in the opinion of the court were considered to be the most urgent needs of the university, the trustees have made to the university a grant of £55,000, the payment being distributed over a period of five years. This includes an annual grant for the period above named of £8,000 for buildings and permanent equipment, the branches of study which are to benefit including natural philosophy, materia medica, physiology, forensic medicine and, if any sum remains over, chemistry or geology. There is also to be for five years an annual grant of £2,000 for teaching, including the endowment of a chair of geology, for which the capital sum is £7,500. The annual grant to the library for the same period is to be £1,000. The University Court has now allotted sites for new buildings for the department of natural philosophy and for the department of materia medica, physiology and forensic medicine and public health, and progress with these buildings may be expected without delay.

At the University of Pennsylvania senior fellowships of the value of $800 for those who have already taken their doctor's degree have been awarded. In zoology, to Dana B. Casteel, of Tarentum, Pa., A.B. (Allegheny College, 1899), A.M. (Ohio Wesleyan, 1900); in mathematics, to Lewis I. Neikirk, of Boulder, Col., A.B., M.S. (University of Colorado, 1898, 1901). Ordinary fellowships of the value of $500 have been awarded. In psychology, to Robert H. Gault, of Ellsworth Station, O., A.B. (Cornell, 1902); in biology, to Everett F. Phillips, of Youngstown, O., A.B. (Allegheny College, 1899). The Tyndall fellowship in physics was granted to Leon W. Hartman, of Walton, N. Y., B.S., A.M. (Cornell, 1898, 1899). A special fellowship in mathematics for the year 1903–04 was given to Professor B. F. Finkel, of Drury College, Springfield, Mo. Fellowships for women were awarded as follows; Bennett fellowship in mathematics, to Alice M. McKelden, A.B., A.M. (Columbian, 1899; University of Pennsylvania, 1900). Bennett fellowship in chemistry, to Alice L. Davidson, A.B. (Elmira College, 1902). Moore fellowship in zoology, to Annie B. Sargent, Bellwood, Pa., B.S. in biology (Pennsylvania, 1899).

The formal installation of the newly elected president of Hobart College, the Rev. Langdon Cheves Stewardson, will take place on commencement day, June 17.

The departments of mining engineering and metallurgy at McGill University will be separated. Professor Stansfield will have charge of the metallurgical department, while Professor Porter will continue to direct that of mining engineering.

Dr. Joseph Barrell, assistant professor of geology at Lehigh University, has received a call to a similar position at Yale University.

Benjamin L. Miller, A.B. (Kansas), Ph.D. (Johns Hopkins), has been appointed associate in geology in Bryn Mawr College.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 24, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE POTENCY OF ENGINEERING SCHOOLS AND THEIR IMPERFECTIONS.*

IT is natural at a time like this to revert in thought to the teaching of engineering in the technological schools of the country, and to ponder on the influence which this teaching produces upon their pupils and upon the economic welfare of the land. I have assumed that some consideration of this question will interest my audience today. A discussion of the potency in the body politic of engineering education is particularly appropriate before the school of applied science located under the inspiring heights of your majestic mountains, which afford an unrivaled richness to him who attacks their depths with efforts properly directed by science. Applied science gives you the power of reaching your ore, hoisting, treating and finally smelting it —applied science, which has been taught

* Address delivered before the School of Applied Science of the University of Colorado on November 14, 1902 on the occasion of the celebration of the quarter centennial anniversary of the University.

here and elsewhere to the chemists and engineers of your rugged state.

I am the more ready to discuss this theme here, in the inspiring presence of your mountains and their bracing atmosphere, because you have laid the foundation for, and have the opportunity to build up, a school of applied science (an engineering school) that may stand unexcelled amongst its eastern brethren. True, you are far from the centers of dense population; but the hum of industry is about, and great works are yet to be accomplished before the wealth of your state reaches its highest development; and the engineering school numbering 500 students may be as great as the school that numbers 1,500.

In the building up of your school of applied science, in this, your university, your people must remember that men and money are required. Men who are practiced, and, if possible, great, in two professions—the professions of engineering and of teaching. Money is requisite to pay for the services of these men, and much money for the equipment of laboratories in which they may adequately teach their students—the sons of your state and of its neighbors. In following my remarks, please remember that I bear no mission of instruction to this university; but I make a plea and explanation to those not technically informed friends of the university who may not fully understand, and who desire to know, whence spring the peculiar advantages of technological education and those requirements which demand particularly large expenditures in its adequate support.

During the course of two decades, we as a people have rapidly advanced toward an appreciation of the proper relations of the engineer to his surroundings. The true conception of engineering may be accepted as comprised within the good old definition, 'Engineering is directing the sources of power' (and wealth) 'in nature to the use and convenience of man.' The man who with fullest success follows the profession defined by this keenly conceived sentence must be a man of science, a man of the world, a man of business, and a man who is well acquainted with the trend of human civilization and human aspirations. To make such a man requires the highest thought and effort of the best teaching influences. Michael Faraday (one of the magnificent men whose lives have been dedicated to the commands of pure science) said that it requires twenty years to make a man in physical science, the intervening period being one of infancy. How much more effort must be carefully expended to make a man not only in physical science, but also a man in business and a man in sociology, all in one! Such men are all of the great engineers, measured according to their times; and to them ought to be accorded in their youth the most careful training.

Our engineering college men at their graduation should properly be looked upon as apprentices in the engineering profession. The student must be inspired in college and taught to work for himself in the manner adopted by George Stephenson, when instructing his assistants and pupils. 'Learn for yourselves,' said he, 'think for yourselves, make yourselves masters of principles, persevere, be industrious, and there is then no fear of your success.' The students should be become *thinkers* in college, capable of usefully applying their scientific knowledge therein obtained; and they should be expected to become thorough engineers through experience in applying this knowledge in a manner which may only be gained in an apprenticeship in the industries, similar to the office and hospital apprenticeships of rising young lawyers and doctors.

The methods used at West Point and Annapolis in training officers for the army and navy, and the course of the graduates after leaving those academies, fairly illustrate my point. It is there held that "a man, to know how to teach another man to pull a stroke oar, must get on the stroke oar himself; to be safe as a quarter-deck officer, to give orders for reefing a topsail in a gale of wind, he must himself have reefed a topsail in a wind. To know how to tell a man to ease a weather sheet or to work the gear of any part of a ship, he must have had his practical experience on that same gear. He can not instruct his men properly, he can not command them safely and efficiently, unless he has been through three or four years of hard practical experience, hand in hand with the men in the forecastle. The same thing is true of engineering. No man is fitted to be superintendent (or manager) of a road or works, no man is capable of carrying on large engineering operations until he has had the practical experience which fits him to pass judgment upon what will be the result of the directions which he may give to others."

Four years is but a small part of Faraday's period required 'to make a man' in the physical sciences, and in so short a period (which is the duration of the engineering college course) only the foundations of the engineer (the *man* in science, business and sociology) can be laid. "There is a great difference between reading and study; or between the indolent reception of knowledge without labor, and that effort of mind which is always necessary in order to secure an important truth and make it fully our own," said Joseph Henry; and the engineering college course should be bent toward such a complete and true presentation of thorough science and truth that the student is incited permanently to secure it for himself and make it fully his own—and he may then put it to valuable use in future practice. "It is not enough to join learning and knowledge to the mind; it should be incorporated into it."

The engineering college graduate should be a fertile and an exact thinker, and a man of value upon his graduation; but he can not come to his highest fruition until years thereafter. The speaker would gladly be judged of the success of his teaching by the success attained by his students after years of practice in their profession, but let no judgment be passed (as is so often done in some colleges) upon the basis of wages received during the year after graduation. Our engineering college teaching may be properly condemned if it does not plant those methods of thought which will grow more valuable with the years, and, indeed, become most valuable only after the mature development of the individual.

The engineering course should not be too formal or limited to the expository methods used of old in instruction in classics. Professor Tait speaks the views of the scientist when he says: "It is better to have a rough climb (even cutting one's steps here and there) than to ascend the dreary monotony of a marble staircase or a well-made ladder. Royal roads to knowledge reach only the particular locality aimed at, and there are no views by the way. *It is not on them that pioneers are trained for the exploration of unknown regions.*" The truth of this proposition has been discovered of late years by even the most ardent classicists, and those of us who are called upon to teach men in every one of whom must be developed a certain spirit and power 'for the exploration of unknown regions'—we who meet this unique problem, untrammeled by traditions and strongly aided by the influence and examples of the old engineers, should most fully appreciate and adopt

this precept of a great mathematician and philosopher.

To the engineering student in college the laboratory is of inestimable value. In it he can learn the true relations between science pure and science applied. He can learn to reason true, from cause to effect. His mind may be developed less trammeled than in the class-room, and the inspiration to independent thought may be more readily given deep root. 'Every branch of engineering is becoming more firmly rooted to the scientific bed rock upon which it rests,' and the engineer must be a man of scientific methods, besides being a man of business. He must have learned with the scientist that the price of success is constant, concentrated effort. All this can be taught better in the laboratory than in the class-room. A spirit of indifference which may be readily bred in the class-room, and which is ruinous to success and happiness in life, can not exist in the laboratory that is properly administered. "Genius is nine parts character. The prize is to him who dares, not merely to him who can." *In the laboratory the student may be inspired to dare.*

It must not be thought that I do not give adequate place to the class-room lecture and the text-book recitation. The laboratory work should be carried on in unison with and fortify the work of the class-room. A power may be had through it which can not be gained in the more formal meetings, and I would have at least one half of the time allotted by students to the study of applied science spent in properly supervised laboratories.

The subjects taught are not of so much importance as the effect to be gained in the students' powers, but certain branches lend themselves particularly to the desired end and admirable laboratory equipments in those branches are essential to every fully successful school of engineering. Here the budget of the university is affected. It requires large sums of money to equip, maintain and administer such teaching laboratories, and only few (very few) of the greater engineering schools have yet approached a satisfactory point therein. In this state of great mineral wealth, that has been, and is still more largely being, developed through the knowledge of the engineer, it is reasonable to hope that some public-spirited citizen of ample means will adequately endow the engineering laboratories of this, the university of his own state, so that they may take and hold due rank with the best.

But some of you may say, "What is the benefit to the body politic of the expensive laboratories in our midst? We admit the benefit to the students who personally enjoy their advantages, but is their effect more far reaching?" Most assuredly their effect *is* more far reaching—it reaches to the uttermost limits of the industrial progress and prosperity of the land. In this nation the industrial pursuits are engineering pursuits, and each betterment of clear perception amongst the engineers goes to strengthen the roots of our whole national life. He who truly ponders the question of modern civilization can not but admit that its best and kindest features rest immediately upon the foundations of scientific discovery and invention, and that the engineers and their works constitute the most mighty human force now moving society. Let us think of a few of the engineering feats of the century gone by:

George Stephenson, in 1829, after painfully developing the locomotive, won the Rainhill contest, and the preeminence of steam locomotion over draft animals was established before the world. Here was the christening of that civilization which rests upon the ready communication between the people.

Joseph Henry, engineer by nature and education, scientist of renown, perfected the electromagnet, adapted it for signalling purposes, and taught the world how to operate it at a distance. The fruits of this single application of electromagnetism, brought to commercial perfection through the efforts of the then derided Morse and the brilliant Graham Bell, have twice revolutionized the commerce of the world and incalculably advanced its civilization.

Through the brilliant and daring Ericsson, one of those mighty acts of Providence that sometimes occur in the guise of miracles was wrought in Hampton Roads for the preservation of independence and liberty amongst the race.

These examples from the last century are sufficient to serve my purpose of illustration. The progress of the new century bids fair to magnificently exceed the past.

The engineers of the world may be thought of in connection with three classes:

The scientific followers after principles and inventions.

The plodding constructors and originators of structures.

The engineering plungers and promoters.

The first are to-day by far the greatest, and their preeminence grows with each application of new discoveries to the use and convenience of man. But we must not fail to give proper honor to the faithful workers of the second class, who founded the profession and are yet its mainstay; or to lend due admiration to the brilliancy and daring of the third class.

In the first class are found such names as Rankine, Lord Kelvin, Werner Siemens, John Hopkinson and Joseph Henry, to whom I have referred. In the second class stand Telford, Stephenson, Gramme, Corliss and many others of renown; while James Watt stands as a link between them and the first. The third class lists such men as the admiration-compelling Ericsson, Bessemer, Holly and Morse.

These men, who have so largely contributed their part of blood to the living strength of the industries, whom I have selected to represent the past in engineering, are giants in beneficent influence upon the growth of civilization and the development of the wealth of the world. Their lives will be felt until the name of the nineteenth century is blotted from the memory of man. Each has played his part. The industry-promoting Bessemers more immediately increase the wealth of the world; the steady Telfords and Stephensons contribute much to its permanent comfort and convenience; but the scientific discoverers of principles and engineering inventions appear to lend the most far-reaching influence to the world and its civilization. Let us see what foundation of knowledge now exists upon which such men may base their work.

With all the effort of the centuries since the days of Gilbert and of Bacon, when the validity of experimentally proving natural laws was firmly established, we have really advanced but little towards the heart of nature's secrets. The material progress of the world depends largely upon improvements in our methods of utilizing what we now think of as three factors:

1. The properties of material matter.
2. The characteristics of energy.
3. The characteristics of intellect as found in organic life.

We are yet profoundly ignorant of the ultimate character of either matter, energy or life. Experiments seem to indicate that we may find the clue to the mystery of the first two, but it is yet impossible to assert whether, in our present state, we may reach an entire understanding of their true character. Experimental investigations often become increasingly difficult as we approach the goal of ultimate truth, and the

final attempt to press into the citadel of a cardinal truth may cost more effort than all of the approach through the outer works.

However, we have gained a store of knowledge about materials, energy and organic life, and have organized it in such a way that it seems to point to a few great, generalized facts. We apparently have learned that nature is never idle, but that she is a persistent worker with a steady, cumulative activity in which there is ever a unity and no discontinuity; that there is an ever-present 'dovetailedness' as Dickens, I think, put it. Nature's activities are not isolated and independent of each other, but are apparently all in intimate relation, and governed by the same all-pervading fundamental laws. This is the foundation on which the engineers of the present century have to work. Meager as it is, it is far in advance of that occupied by their predecessors of one century ago.

Of fundamental laws we seem to have proved two—the law of the conservation of energy, as it is called, and the law of organic evolution, which controls the development of life through the 'survival of the fittest.' I spoke of these as proved, and so they have been as far as they relate to the problems of our daily life; but they have been rather deduced by inference, as far as the universe at large is concerned, than established by demonstrations. The law of evolution has been so widely discussed in type and speech, that I may assume on the part of each of you some knowledge of its doctrine, and I will at once pass on.

The law of conservation of energy asserts that energy can not be created nor destroyed. We may transform energy in any manner within the compass of our intellect, but we finish with the same amount of energy as we started with. We may transform the chemical energy of coal, by combustion in a boiler furnace, into heat energy, and this may be utilized to 'raise steam.' The energy in the steam may be transformed into mechanical energy by means of a steam-engine, and this into electrical energy by a dynamo. The electrical energy will be less than the original chemical energy because some of the heat has gone to contribute warmth to the surrounding air and solid bodies, but the available electrical energy added to all of this heat (which has not been destroyed, mind you, but continues to exist as heat) *makes a sum which exactly equals the original chemical energy in the coal.*

Another fundamental law has been ordinarily accepted as governing; this relates to matter. You all know that matter is apparently indestructible. Transform it as we may; change, by combination, the matter which we call hydrogen and that which we call oxygen into that which we call water; again, combine this with metallic sodium to form caustic soda; again, form other combinations or compounds—through them all we have apparently transformed matter without gain or loss, and hold the same mass at the end of our transformations as we held at the beginning. The chemists have been making a very thorough study of this idea for years past, and they do not seem convinced that it represents a universally applicable law; but for all present purposes of the engineer it may be safely accepted.

In accordance with these laws relating to matter, energy and life, and their myriad corollaries, the professional engineer must carry on his work through the discovery of scientific principles and their useful combinations. Invention is no longer a mere question of designing a working machine. That may now be safely left to the skilled mechanic; while the engineering inventor must discover new combinations of scientific principles and

give them applications that are useful to man, in order that they may more perfectly contribute to the support of the race. Men must be educated for this purpose in our schools of applied science. This education can not be efficiently gained without the help of the schools.

Again, new principles must be discovered and great laws deduced, and contributions must be levied from them for the support and advancement of the race. It has long and justly been regarded a signal achievement to discover an important phenomenon or principle in science, and the discoverer has been stamped a learned and great man. It is still a signal achievement to discover, but the discoverer may add luster to his fame in our time by directing the application of his discovery to the service of mankind, so that no undue delay may be suffered to occur before it too contributes to the welfare of civilization. These men also may be most effectively educated in our schools of applied science.

The motive force of progress and civilization at the opening of the twentieth century is infinitely greater than at the opening of the nineteenth; largely due to discoveries and the world's slight education in science; and the possibilities following great discoveries are equally increased. Carrying this education of the people in applied science to its farthest limit must accentuate the progress, bringing with it those trains of good that follow in the wake of broader intelligence and wider opportunities. Every industry, every line of transportation or system of intercommunication, every branch of useful endeavor, has profited by the growth of scientific teaching and the work of the engineering schools; and civilization, which spreads, fattens and grows great through transportation and intercommunication between peoples, has been the gainer. Manifestly the influence of the schools of applied science is vastly greater than the effect directly produced on their individual students.

Consider the growth of our own people! The nineteenth century opened while the meridian crossing the center of our population bathed half its length in the Atlantic Ocean. Now it approaches its baptism in the Mississippi. The opening of our fertile domains, of which this tells the tale, is a story of transportation and intercommunication—the steam railroad and the electromagnetic telegraph, applied science allied with vigilant energy.

Much was formerly preached of a discord between theory and practice in engineering, and the old specter has not yet been laid for some. But no such discord ever existed except in the minds of the unlearned who failed to see that it was the finger of truth which washed away their rule of thumb; and with even them it existed only as the suspicion arising, as Bacon says, 'of little knowledge.' Even this phantom was laid in 1855 through an admirable address by the learned engineer, Professor Rankine, whose discoveries added much to engineering practice, and whose early death was so deeply mourned. After tracing the development of meager scientific knowledge and mechanical practice amongst the ancients, Professor Rankine makes the following observations:

"As a systematically avowed doctrine, there can be no doubt that the fallacy of a discrepancy between rational and practical mechanics came long ago to an end; and that every well-informed and sane man, expressing a deliberate opinion upon the mutual relations of those two branches of science, would at once admit that they agree in their principles, and assist each other's progress, and that such distinction as exists between them arises from the difference of the *purposes* to which the same body of principles is applied.

"If this doctrine had as strong influence," continues Rankine, "over the actions of men as it now has over their reasonings, it would have been unnecessary for me to describe so fully as I have done the great scientific fallacy of the ancients. I might, in fact, have passed it over in silence, as dead and forgotten; but, unfortunately, that discrepancy between theory and practice, which in sound physical and mechanical science is a delusion, has a real existence in the mind of men; and that fallacy, though rejected by their judgments, continues to exert an influence over their acts. Therefore it is that I have endeavored to trace the prejudice and practice, especially in mechanics, to its origin; *and to show that it is the ghost of a defunct fallacy of the ancient Greeks and of the mediæval schoolmen.*"

Enough has been said to illustrate my point. The influence of schools of applied science is vast and far-reaching, and every dollar spent in the establishment and maintenance of well-considered schools not only returns abundantly to the states in which the schools are centered, but their usefulness may extend to the nation and the world at large. Patriotism now needs no better object than the founding of such schools.

We may now justly turn to enquire into the character of the education for the individual that may be derived from such schools. Herbert Spencer names in a sentence the true criterion by which to judge of the adequacy of an educational process, and I can not refrain from a quotation: "To prepare us for complete living," says he, "is the function which education has to discharge; and the only rational mode of judging of any educational course is to judge in what degree it discharges such function."

Here arises the query, What is complete living? Spencer answers this, but we may each likewise answer for himself out of his personal consciousness and experience: An education for complete living includes training the faculties of self-preservation, the faculties of self-support, the faculties of proper parentage, the faculties of proper citizenship, including the betterment of our political and social relations, the faculties of properly enjoying one's leisure and lending enjoyment to others. Education, to use the words of Huxley, 'ought to be directed to the making of men,' and must include 'things and their forces, but (also) men and their ways.' We can not, we must not, cultivate one to the exclusion of the other.

The study of science and its applications, in the atmosphere of our better engineering schools, certainly lends largely to each of the faculties and powers which are required for complete living. It has been asserted that it lends more immediately to the earlier and less disinterested ones; but this assertion I must deny. The profession of the engineer demands a creative imagination cultivated to the sober, clear sight which sees things as they are; and a quick appreciation of the effect of sentences and their combinations; which make him akin to the creators of art and literature, and give him in large degree the more disinterested faculties named. I am willing to yield to no one in an appreciation of art, literature and music as an element of the highest importance in the education which goes to relieve the strain of an overarduous professional existence and to smooth the relations between fellow men; and I can not but regret that these liberal branches must be omitted from the curricula of the engineering schools. But I also can not fail to remember that an education in applied science brings keenness of perception, and recognition of truth and

beauty, to its average followers, from which springs an appreciation of art and literature and music which rivals that produced in the most gifted product of the literary colleges. "With wisdom and uprightness a nation can make its way worthily, and beauty will follow in the footsteps of the two, even if she be not specially invited."

Of all the intellectual faculties which we cultivate through education, the most useful is the faculty of sound and mature judgment; and of all, this is the one most often deficient. Here the laboratories of applied science are strong in their influence for good. That man who follows the laboratory courses in one of our well-administered engineering colleges and goes forth without improvement in his faculty of judgment and a quickening of his executive powers is an unworthy son of man. The force of straight thinking can not be over-estimated. 'Victory is for the people who see things as they are without illusion, who do not take phrases for facts,' and straight thinking is one of the gifts derived from the engineering laboratories. The engineer's duties require that he shall possess this most important of mental attributes; and fortunate it is for the profession, for it makes of every great engineer a man of greatness. Do you question this statement? If you but enquire of the past you will find it proved. Amongst no class of men is found a broader sympathy with humanity and a more liberal view of the progress of the race than is exampled in the lives and works of the great engineers, and none have been better or nobler citizens.

Yet, withal, it must be a matter of concern in the technological schools lest the lines be drawn too close, and the students become absorbed in an ungenerous, over-earnest pursuit of details. Breadth of view may be sacrificed unless our teachers be men of ripeness and power, and the students learn through them that each element in the life of the 'complete liver' has of itself an intrinsic merit. This fear of a belittled outlook for some of our students, whose ambitions or mental aspirations may have never been stirred in their pre-college days, would be dissipated could the personality of each teacher in the schools of applied science include that rare combination of mellow scholarship, clear scientific perceptions and engineering common sense which we occasionally meet and which a few colleges rejoice to retain in their midst.

The teaching force of an engineering school should ideally be made up of engineers—men who have seen some years of successful practice (and preferably continue to hold some practice), who are held in esteem for such by their brethren in practice; but who have a joy in the quiet life of the scholar which is traditionally associated with the colleges, and who may thus be contented when outside of the immediate tide of engineering production. Yet the teaching of engineering is a question of pedagogy rather than of the engineering profession, and it must be dealt with with this clearly in view. Here is one source of many profound imperfections in our existing schools. I venture to say that it is the exception rather than the rule when a teacher in a school of applied science has given any consideration to the tenets of psychology and pedagogy, upon the due application of which depends much of his success in properly impressing his students. These teachers are doubtless no greater offenders than their brethren in the so-called colleges of liberal arts, but in this is found no palliation for the offense. Fortunately, a goodly proportion of the older ones amongst the devoted men who are contributing their blood and brains to the welfare of the

engineering schools are often endowed with a natural sense of fitness in the processes of education, and the younger gain due appreciation of methods from association with them. Yet I must regret to say that proposals relating to the curricula of the technological schools are frequently offered, which unpardonably violate every tenet of good teaching.

This condition ought not to exist, and it can not continue after the truth has seized hold: that these schools are facing a teacher's problem, which must, indeed, be met by engineers with all of the directness and power of the engineer's best efforts—but that the problem can not be solved as one solely relating to the engineering profession.

It is sometimes thought that men who can not make a success in business life are just right for teaching. This is entirely wrong, and the idea should not be admitted for a moment in any modern technological school. The discontented man who has made a failure in business life will certainly make a failure in teaching engineering. Engineering colleges should avoid 'men who are fools in working,' even though they are 'philosophers in speaking.' Enthusiastic men are wanted; they may be young men, if needs be, but they must be paid well enough so that they may take places as self-respecting members of the engineering profession, and they must be properly chosen with respect to their qualifications. These men must be good professional engineers; they must possess power and satisfaction gained from engineering research, and from attainments in other lines than those of purely professional acquirement; but sound teaching is their work of first importance. It is very difficult to teach well, but that is no excuse for admitting poor teaching into the engineering schools.

The problem in the engineering colleges is rendered more complex by the character of the curricula, which require that the students shall follow for a period what may be denominated preparatory science instruction before they enter upon the truly professional work. In the latter, at least, the teaching should be largely by inspiration and suggestion.

The process of gathering, organizing and assimilating knowledge by each student should, as Spencer suggests, be as far as possible a process of self-evolution. If a professional student will not follow his work with zest and satisfaction, it is a thankless and doubtful task to force him to it. The best method for the teacher in professional subjects (but the method of all methods difficult to follow without abuse) is indicated in Kipling's verse:

> "For they taught us common sense,—
> Tried to teach us common sense—
> Truth, and God's Own Common Sense
> Which is more than knowledge.
> * * * * * *
> "This we learned from famous men
> Knowing not we learned."

The engineering colleges are at fault in not more fully developing the initiative, the enterprise and the executive powers of their students, though this is a difficult part of the task of 'making a man.' But that thing must be done in order to make successful industrial engineers. It can be done largely by influence, by the character of the treatment of the students, and by the sort of ambitions that are put into them. It can be done in some degree by the selection of the work assigned to the curriculum, but the subjects studied are of less importance than that the students learn,

> "Truth, and God's Own Common Sense."

The teacher must remember when he tries to teach by inspiration, even though his time and method be wisely chosen, that he may expect to receive in the class-room

some hard blows to his self-regard and his esteem for his teaching. He may pour stimulating thoughts over his students day after day for weeks, and finally find that few have taken root. He may even be brought to that state of desperate depression that is illustrated in one of Turgeniev's novels when its hero, Dmitri Rudin, failed to succeed in his post at the university. The engineering teacher—provided he is sure of his time and method—may take heart by remembering this: that if every stimulating thought presented to his students, whether relating to professional applications of theoretical principles or directly to the development of initiative, self-reliance and executive powers—if every stimulating thought took root in every student's mind, those minds would become over-burdened cyclone centers of thought; and if one real thought takes root from time to time in each student's mind the teacher may be truly satisfied.

I have already suggested that the question of professional instruction in the engineering schools is entangled with the problem of leading the students through a course of preparatory science looking towards the professional studies. The medical schools may and largely do escape this responsibility by requiring their students to pursue a liberal college course before embracing the professional courses. The existing plan of the medical schools is ill-advised when viewed from the engineer's standpoint, but we hope that some inviting plan may yet result from the proposals made by several great university presidents in respect to coordinating the liberal and professional college courses. We would gladly welcome the old-time college course and the old-time preparatory course, especially as far as they made men of vigorous thought who could spell and cipher; and we now gladly receive and encourage all students who have been willing and able to complete an academic college course before entering upon their technological studies.

Broadly, however, until there arises such an advantageous plan of coordination which may be adopted with advantage to our students and to the profession, the engineering schools will continue, as heretofore, to instruct their students for four years immediately following the high-school course—the first two years being largely filled with mathematics, chemistry, modern languages, drawing and other subjects leading to the professional studies of the engineer. These students come freely to the college at an age between seventeen and twenty, equally immature in mind and body—and one part must not be trained at the sacrifice of the other. "It is not sufficient to make his mind strong; his muscles must also be strengthened; the mind is over-borne if it be not seconded."

Montaigne puts it very gracefully: "It is not a mind, it is not a body which we erect, but it is a man, and we must not make two parts of him." A prime requisite to success in life 'is to be a good animal,' and the engineering schools must look after the bodily and social welfare of these entering students in a way that is not required of the medical school with its course largely recruited from the liberal college. These students should be encouraged to enter into the various interests of the life around them, especially of the college life, including its social affairs and its athletics and gymnastics. The extra responsibility which thus rests upon the teacher in the engineering schools equally increases the effect of the influence with which his personality affects his students. The latter is a recompense that every lover of teaching will willingly make sacrifices to obtain.

My discussion of my subject has been brief, though, perhaps, as long as your desire. I have tried to show you that the wide influence of the engineering schools is of two branches: First, a direct effect exerted through the graduates extending the useful applications of science to the advantage of man (which is the effort of every true engineer); second, an indirect (but equally important) effect resulting from the admirable education disseminated amongst the people. And I have pointed out not only elements of great educational strength, but also some sources of weakness in the schools. It has been my particular wish to bring to your mind some image of the potent influence for good which has been in the past, and still more may be in the future, borne on the body politic by these schools, and to impress you with the desirability of bringing to their support the same bountiful endowments that are now justly flowing to the support of the medical schools. I trust that I may have interested you and that I may have reached, in some degree at least, my object.

In the course of my remarks I have had frequent occasion to use the phrase 'applied science.' You must not mistake me. Applied science is not something set off by itself and differing from 'pure science,' so-called. Far from it. It is pure science, if you wish, pursued in the stimulating, nutrient atmosphere bred of the belief that all scientific knowledge returns to its possessor great good in proportion to the advantages which he, through it, brings to mankind. Such an atmosphere is to be found in many of our medical schools and, I hope, equally in our engineering schools.

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*STAMENS AND PISTILS ARE SEXUAL ORGANS.**

The statement in the above title will be received by some of my hearers with wonder that so obvious a matter should need any discussion, while by others, especially those versed in the modern morphology, it will be met by emphatic dissent. Yet I am convinced of its truth, and venture here to rise in its defense.

The discussion of the subject is not new. Professor L. H. Bailey, in Science for June 5, 1896 (reprinted in his 'Survival of the Unlike,' page 67), defended, with his usual clearness and vigor, the application of the sex-terminology to stamens and pistils; and he was answered in the same journal for June 26 by Professor Barnes, who maintained the strictly morphological view that the sex-terminology should be restricted to the gametophytes, or so-called sexual generations, within the pollen grain and the embryo sac of the ovule. Recently this morphological view has again been emphasized by Professor Ramaley, in Science for June 20, 1902, and he puts the case in its extreme logical form when he says: "The stamens, therefore, can not be male organs, nor the carpels female organs. * * * There are no such things as male and female flowers, nor flowers which are unisexual or hermaphrodite." This view I hold to be an error, for the reasons which follow.

To prevent misunderstanding it should be said at the outset that there is no difference of opinion as to the morphological facts involved. We all agree that the contents of the embryo sac when it is ready for fertilization, and of the pollen grain when in the corresponding condition, are the gametophytes, the precise morphological equivalents of the prothallus or sexual

* Read before the Society for Plant Morphology and Physiology at the Washington Meeting, December 30, 1902.

generation (gametophyte) in the pteridophytes. Where I differ from the extreme morphological view is just here, that while I admit that all sexuality, in whatsoever that may consist, is confined to the gametophyte in the lower forms where the two generations (as best manifested in the ferns) are structurally, morphologically and physiologically distinct, I deny that sexuality is confined to the gametophyte in the higher plants, where the gametophyte has become structurally incorporated with, and physiologically dependent upon, the sporophyte. If, then, sexuality is not confined to the gametophyte of the flowering plant in fact, obviously it should not be in terminology.

We must here note an important point in the discussion, namely, that it has two distinct phases: (1) There is the matter on which Professor Bailey argues, that, as a matter of propriety in usage, the old and familiar sex-terminology should not be wrested from its prior and consistent analogical significance and given a new and technically limited morphological application. (2) There is the new contention here defended, that a restriction of the sex-terminology to the gametophyte in the flowering plant is incorrect in fact. We may best consider them separately.

As to the first, and allowing for the moment (for clearness of argument) that sexuality may be confined to the gametophytes in the flowering plant, I think Professor Bailey's argument for the retention of the sex terminology to its present application is perfectly conclusive. He is certainly correct in his contention that the original sex-terminology was based upon analogies, with no thought of homologies; a male organ was that structure which secured the formation and functioning of the male element, and such an organ a stamen is; a female organ was that structure which secured the formation and functioning of the female element, and such an organ a pistil is. Now morphologists have no right, I believe, to attempt to wrest the sex-terminology from its consistent, intelligible, widely-used and *prior* application to analogies, and give to it a new and technical use for homologies, an attempt made still less excusable through the claim of its advocates that the earlier application is erroneous and only theirs is correct! Science is expected to apply new terms to its discoveries, and new conceptions; it should not attempt to appropriate an older terminology to new uses. As a matter of fact science *has* given an ample terminology of its own to the parts of the plant involved in the present discussion, and the confusion which has arisen in teaching and elsewhere is the result of a neglect to make full use of those terms, a neglect due no doubt to the mistaken notion that an adaptation of the older terminology to the new conceptions would conduce to clearness. I am of opinion, based upon some experience, that the difficulties in teaching, of which Professor Barnes and Professor Ramaley speak, can be met by a rigid application of the definite scientific terms *sporophyte* and *gametophyte*, with an abandonment of the misleading terms *sexual* and *non-sexual generations*.

We consider next the second point, whether, as a matter of fact, sexuality is confined to the gametophyte in the flowering plant. At the one extreme is the gametophyte of the fern, independent anatomically, morphologically and physiologically from the sporophyte; to it the name sexual generation (viz., that generation which produces the sexual elements) correctly and appropriately applies. At the other extreme is the gametophyte of the specialized phanerogam, where the gametophyte is formed, nourished and de-

veloped entirely within the tissue of the sporophyte, in the most intimate anatomical and physiological contact and dependence upon the latter, and is quite incapable of developing the sex cells without the direct cooperation of the sporophyte. It is plain that a part at least of the work of nourishing and preparing the sex cells for their functions, assumed by the prothallus in the fern, has in the phanerogam been transferred from the rudimentary prothallium to the highly developed sporophyte. The morphological line between gametophyte and sporophyte can still be traced (though only through recondite comparative researches), but the physiological, and to a great extent the structural, line between the two has vanished. The gametophyte, therefore, does not constitute a 'generation' in the sense in which the word was originally used in the ferns, for the physiological equivalent of the sexual generation of the ferns is, in the phanerogam, the gametophyte plus part of the sporophyte.* Not only are the tissues of the sporophyte in the immediate vicinity of the gametophyte specialized to aid the latter in its work of developing the sex cells, but this is true (though to a lesser extent) of the sporophyte tissue for long distances away, even to the confines of the parts we call stamens and pistils, so that I can not doubt that some at least of the attributes properly belonging to a 'sexual generation' have been transferred that far back from the gametophyte into the sporophyte. It is no objection to this view that I can not tell where in the ascending series the 'sexuality' begins to pass over to the sporophyte; even if we knew precisely the actual stages in the evolution from fern to phanerogam (which we do not), and even if we were agreed upon a definition of sexuality (which we are not), it might still be impossible to tell precisely, so subtle are the gradations of natural processes, and so regardless are they of definable categories.

The sum of my argument, then, is this —that in the phanerogams the physiological line between the two 'generations' has vanished, and that a large part of the original function and attributes of the gametophyte has been transferred to the sporophyte which has had its tissues specialized to that end; hence the gametophyte of the phanerogams is no longer a 'sexual generation' in point of physiological fact, and it is misleading to use the name as an expression of morphological relations; sex not being confined to the gametophyte, the sex terminology can not be.

Only the morphological line remains to mark off the two generations in the phanerogam, but it is precisely this fact which has caused the whole difficulty. Morphologists have found so great a satisfaction in tracing the intricate but beautiful homologies from fern to phanerogam, that their attention has become centered exclusively upon the morphological phases of the subject, to the exclusion of its physiological aspects. They have forgotten that sexuality is more a matter of physiology than of morphology, and that function cuts across morphological boundaries in the most irrelevant manner. They have fallen into that error, against which Goebel has so forcibly warned us, of attempting to interpret morphology without reference to function, a method which can lead only to

* The intimate physiological interlocking of gametophyte and sporophyte is strikingly illustrated in the phenomena of polyembryony, where the sporophyte (nucellus) has acquired the power of producing embryos within the embryo sac, which embryos, although purely asexual, have the general form and course of development of embryos produced by the gametophyte. The physiological equivalence of perisperm and endosperm points in the same direction.

a sterile formalism quite unrepresentative of nature's unconventional methods. That they have in this case fallen into this pit is due, I think, to the misleading influence of words. Starting with forms in which there are two distinct generations (as in the ferns), and applying very appropriately the terms *sexual generation* to the gametophyte and *non-sexual* to the sporophyte, they have kept these names for the morphologically equivalent stages in the evolution to the phanerogam, not noticing the gradual emptying of the names of their original physiological significance; until, finally, the names themselves have come to stand in their minds for the facts they state, and to be accepted as evidence, or even as final authority, upon the points at issue. The mischievous terms *sexual* and *non-sexual generations* have been and are the cause of the whole difficulty. Let us abandon them.

W. F. GANONG.

SMITH COLLEGE.

A TROPICAL MARINE LABORATORY FOR RESEARCH?

DESPITE the creditable activity which has developed in our country in biological research during the past few years, it must be confessed that it is difficult to explain the neglect upon the part of our naturalists to avail themselves of the opportunity to study the marine life of the tropical Atlantic, especially as one of the most, if not the most, favorable locality for the prosecution of such researches lies within our own territory at the Tortugas, Florida.

As Professor Davenport aptly states, we know more of the life of the Red Sea than we do of that of the Caribbean and Gulf of Mexico.

Our knowledge of the life of the tropical Atlantic is almost wholly dependent upon the results of brief and cursory expeditions, and the innumerable researches which require a permanent station for their successful prosecution have hardly been attempted. The mere systematic study and classification of forms in our tropical waters is glaringly incomplete, while we have almost failed to take advantage of the exceptional facilities which a tropical station offers for physiological and embryological studies, owing to the fact that the water in the tropics may be readily maintained at the same or at even a lower temperature than that of the ocean itself. In consequence of this and of the remarkable purity of the ocean water at the Tortugas and Bahamas, it is possible to rear larvæ or carry out physiological experiments with far better success than is attainable in our northern stations. If much has been accomplished in work upon the limited fauna of the southern New England or Carolina coasts, how much more might be expected from a study of the far richer fauna under the more favorable conditions attainable in the tropical Atlantic.

The cause of this neglect has been that none of our educational institutions has been able to afford to maintain a permanent laboratory in the tropics, and no coöperation has yet been, or is likely to be, effected which could bring such a laboratory into being.

The establishment of the Carnegie Institution has suddenly changed the aspect of the case, and as it appears to be the province of this institution to support important research work which none of our existing institutions has been able to afford, the prospect for the establishment of a permanent research laboratory in the tropical Atlantic appears for the first time possible.

As far as the writer is aware, no application for the establishment of such a laboratory has yet been addressed to the

Carnegie Institution. Were such an application to be made, it would appear that it should be national in character and that it should aim to secure a laboratory under conditions which will meet with the entire approbation of our leading naturalists, and which will be visited by an able and numerous clientage. The Carnegie Institution being national in scope, is the only one in the country which may hope to secure completely this combination of happy auspices, should it decide to establish such a laboratory.

In order to determine the sentiment of the country concerning the advisability of establishing such a laboratory, letters were sent to leading zoologists of the United States and Canada. Similar letters might also have been sent to the marine botanists, but it appeared probable that the general consensus of opinion concerning the proper situation and advisability of establishment of such a laboratory could be gleaned from the replies of the zoologists alone.

These letters read as follows:

An expression of opinion by leading biologists concerning the advisability or inadvisability of establishing a marine biological laboratory for research at the Tortugas, Florida, or at some other station in the American tropics, will be gratefully received by the undersigned. No definite steps leading to the establishment of such a station should be undertaken until the consensus of opinion and the desires of the leading workers in biology have been ascertained.

Do you approve or disapprove of the plan of establishing a laboratory for research in marine biology at the Tortugas?

If not, what alternative would you suggest?

If established would the station be of any practical service to you, to your colleagues, or to your students?

Criticisms as well as commendations of the plan are equally desired, and both will be published and discussed in a judicial manner in some leading journal of science.

As the replies may be numerous, it is desirable that each should be brief. Your letter may be addressed to the undersigned at the Museum of the Brooklyn Institute of Arts and Sciences, Eastern Parkway, Brooklyn.

Replies were received from the following forty-three zoologists: M. A. Bigelow, Chapman, Conklin, Dall, Davenport, Dean, Dodge, Edwards, Evermann, Gill, Hargitt, Herrick, L. O. Howard, Jennings, H. P. Johnson, D. S. Jordan, V. L. Kellogg, Kingsley, Lillie, Lucas, MacBride, McMurrich, Metcalf, Mills, Minot, Montgomery, Morgan, Neal, Nutting, Ortmann, G. H. Parker, Rathbun, Ritter, Sedgwick, Springer, R. M. Strong, Treadwell, Verrill, H. B. Ward and four others whose names we are not at liberty to reveal.

All expressed the hope that a well-supported marine laboratory for research might be established in the tropical Atlantic.

Twenty zoologists expressed the opinion that the Tortugas, Florida, would be the best situation for such a laboratory. Among these at least twelve have been upon one or more expeditions to various parts of the American tropical Atlantic.

Sixteen zoologists expressed the hope that a station might be established somewhere in the tropical Atlantic, but were non-committal concerning the best locality. Only three of these sixteen are known to have been upon any expedition to the American tropics.

Seven favored localities other than the Tortugas. Four of these preferred the Antilles,* two the Gulf coast of the United States, and one the Bermudas. All of these seven have been upon expeditions to the tropical Atlantic.

Recapitulating, we see, that of the twenty-two who have been upon expeditions to the tropical Atlantic, twelve favor the Tortugas, three are non-committal, four prefer the Antilles, and one the Bermudas. It is apparent that among those who can speak from personal experience

* Jamaica was specified by two.

the majority favor the Tortugas as a fit locality for the establishment of the laboratory.

Concerning the use which would be made of a tropical laboratory, twenty-two stated that they would expect to visit it and carry on research work under its auspices, sixteen either failed to answer the question or were non-committal, while five stated that the laboratory would be of no personal use to them.

It would appear that, in order to insure the constant use of such a laboratory, it would be necessary to assure the proper publication of all creditable researches and to defray at least a portion of the traveling expenses of students. The latter provision would probably be essential for the first few years of the existence of the station, but would become less imperative later.

We here reproduce a few of the letters which were received and which throw light upon the situation from various points of view:

"From an ornithologist's point of view the Tortugas afford exceptional opportunities for the study of bird migration and of the life history and social relationships of colonial nesting birds. Having no resident land birds, and evidently lying in a highway of migration between western Cuba or southern Yucatan and Florida, the host of migrating birds which visit the Tortugas in the spring and fall write their records on a clean page. That is, the movements of migratory birds are not confused with those of resident species or of merely local wanderers, as is apt to be the case on the mainland. This would be especially true in studying the southward migration of birds which, in the Tortugas, would probably begin late in July. I say probably, simply because we as yet know little or nothing about the early stages of the migratory movements from the United States. At this time, too, an observer in the Tortugas would be admirably situated to secure much interesting data as to whether old or young birds lead the migration of their species. Comparison of his observations with those already recorded from the Florida mainland would also show how much of the Tortugas migration was directed to or from Florida and how much of it might be termed pelagic. In short, many of the phenomena of bird migration would be observed under far less complex conditions than occur on the mainland.

"The colonies of terns which annually visit the Tortugas to nest would afford a most interesting subject for continuous study by a student who at the same time could be engaged in laboratory research along other lines. The remarkable tameness of these birds permits of that close study of the individual without which the study of the species is always more or less lacking in definiteness, and I know of no more promising subject for ornithological investigation in the field than the life-history of the noddy tern and its social relationships to birds of its own species as well as to those with which it is associated."

FRANK M. CHAPMAN.

"I am heartily in favor of the plan of establishing a research laboratory at the Tortugas, for the following reasons:

"1. The fauna of the coast of the Gulf States is less well known than that of the Red Sea, and is the least known of our coast line, although it is probably the richest. This is partly due to the fact that students of zoology are usually free only during the summer, when the Gulf coast is supposed to be too hot. Your plan will attract occasional winter workers and others in the spring and autumn.

"2. The isolation of the Tortugas is their safety. Parasitic diseases are to be feared only in a larger community.

"If established, I should be tempted to visit the laboratory; I have no doubt Chicago University would be represented by workers there nearly every year."

CHARLES B. DAVENPORT.

"I am very glad, indeed, to send you an expression of my opinion regarding the fitness of the Dry Tortugas as a point for the establishment of a zoological station. For I have collected myself in Florida waters, and I know at first hand what valuable material is to be secured there for research. As far as I can understand the problem of faunal distribution, water currents, and the like, I am decidedly of the opinion that there is no better general locality for a zoological station than the one which you are interested in. The only objection to it, as far as I can see, is the matter of ferriage to and from the mainland, but I think this is counterbalanced by the ad-

vantages derived from the offshore currents. My belief is strong that we have reached the point in our zoological studies when it is necessary to provide investigators with working facilities at a number of conspicuous faunal points along our coasts, and I think that there could be no better move in this direction than by the establishment of a station in the locality you suggest."

Bashford Dean.

"I highly approve of the plan of establishing a laboratory in this or a similar locality, as part of a general plan of a series of stations on the Atlantic coast in the centers of the successive Atlantic faunæ.

"The station would certainly be of great practical service to many American zoologists, and I would hope to make some use of it personally. It appears to me that such a station should be open throughout the year; in this way it would best supplement the uses of the more northern stations, which are principally summer stations. At present there is no opportunity in this country for marine work in the late fall, the winter and the early spring, and I am very sure that in a short time, when the advantages of the location became known, the station would have numerous visitors during these portions of the year. So far as the fauna differs from that in the vicinity of more northern stations, the location would possess advantages for special workers at all seasons."

Frank R. Lillie.

"Your letter asking my opinion regarding the establishment of a marine biological laboratory for research at the Dry Tortugas has been received.

"In reply I will say that I am enthusiastically in favor of the plan. As you know, I have some personal knowledge of the Tortugas as a field for biological work, having spent some time there with a party from this university, and I have frequently expressed the opinion that it is the best place for a laboratory that I know of on the eastern coast of the United States. It has several advantages that seem to me to be unique, and no very serious disadvantage, now that the quarantine station has been removed.

"If such a station were established I am sure that it would be of practical advantage to me and to students from this university.

"Of course a good deal depends upon the plan that is adopted. I am not informed as to whether you have formulated any definite plan. If you have, I would be glad to know of it, and would like to have this university have some share in the matter. Of course I can promise nothing officially, but it seems to me that the state universities of the west could be led to see the great service that such a station might be made to render them. The Tortugas are no farther than the New England coast, so far as western institutions are concerned, and the faunæ of the two are not comparable, so great is the advantage of the Tortugas over the North Atlantic coast.

"I would be glad to help in the furtherance of your plan in any way that I can. Please keep me advised as to progress."

C. C. Nutting.

"Your inquiry regarding the advisability of the proposition depends upon the standpoint of the individual for its reply. The *practical* question is whether sufficient funds can be secured for the proper establishment of the laboratory, and this is a problem which will color a reply to the subsequent questions, for I do not believe that a poorly equipped or otherwise unsatisfactory laboratory would be of any very great advantage to the country at large, however much it might be useful for the few workers who under such conditions might spend a short time at it.

"I have prefaced my remarks by this statement for the reason that so many projects have been entered upon in this country without means for putting them into satisfactory operation, and with the result that they have been of comparatively limited value.

"Reverting now to the specific questions proposed, and replying to them simply from the scientific standpoint, and without regard to the practical questions of access as well as support as mentioned above, I may say as follows: The location appears to me as peculiarly fortunate for the investigation of marine biology and as offering better possibilities in prospect than any of which I know in this country. I can foresee that the station would be of much practical value to the country at large. Whether, considering the distance of Nebraska from the ocean and the expense incident to the trip, it would be possible for me individually or for my students to take advantage of the opportunities offered I can hardly say in advance. I know from the way in which your article was discussed in our zoological seminar that no project has appealed more strongly to its members than precisely this one. I feel as if it were time that we had a satisfactory subtropical laboratory, and I know of no place which would be superior to the location you suggest."

Henry B. Ward.

"In general I think that the establishment of a tropical station is highly desirable, but I must confess that, so far as I am personally concerned, or so far as any of my students are concerned, it is not probable that we would be able to make any practical use of a station at the Tortugas. The one great objection to the Tortugas as the site for a station is its relative inaccessibility. One other objection has occurred to me, namely, that the fauna is exclusively marine, whereas by locating a station on some one of the larger islands—for example, Jamaica—it might be possible to have a considerable tropical land fauna as well as marine fauna. I have never visited the Tortugas and can not speak from experience as to whether the advantages there offered entirely overcome the objections I speak of. If so, the station ought to be located there irrespective of these objections. If, however, similar advantages can be found, say on the island of Jamaica, I should myself prefer to see such a station established at that point."

E. G. CONKLIN.

"The proposition to establish a marine laboratory on the Tortugas Islands certainly has much to commend it, and so far as the fauna of the Gulf Stream is concerned, probably, as you suggest, no better station in the West Indies could be chosen.

"The advantages of small islands in affording immunity from tropical diseases are no doubt considerable, yet it must be remembered that a greater land area and a more diversified coast add intensely to the interest of students who go to the tropics for zoological or botanical studies.

"I hope that the attempt to inaugurate a tropical marine laboratory will become a national one, and that before any site is definitely chosen a thorough zoological reconnaissance will be made of the larger islands, particularly of Porto Rico, on its southern shore. The future may see the establishment of a large central station with one or more subordinate ones. In any case you have advanced the idea by setting forth the strong claims of the Tortugas, and I hope that the zoologists of America will take up the question in earnest."

FRANCIS H. HERRICK.

"The plan to have a laboratory in the Caribbean region is excellent. It is something we have long needed. What you say concerning the favorable character of the Dry Tortugas would lead one to think this an exceptionally good location, but this is a point that requires very careful and thorough consideration. It would be well to look to the fate of laboratories established on small islands and in other out-of-the-way places. We have the Anderson Laboratory on Penekese as a horrible example. A marine laboratory should be in touch with the rest of the world. Perhaps the Tortugas fulfill this condition; but the land fauna is to be considered. In a region like the Caribbean especially it is no less important than that of the sea. Insular forms are in constant danger of extinction; hence it is incumbent upon us of this generation to give them as much study as we can. It is doubtful whether the Tortugas or even the Bahamas offer so good a site as the Greater or even the Lesser Antilles, from this point of view."

HERBERT P. JOHNSON.

"Never having been there, I can not speak of the place as a desirable residence, nor of the facility for going and coming, which are of course very important considerations for students and scientific men, but my impression has been that it was rather expensive going there from the north, and not a very agreeable climate except perhaps in the coldest months. As for the marine fauna there, I can speak in the highest terms of its richness and variety, for I have studied the fauna of that region for many years. There can be no question as to the excellence of the place for obtaining abundant material of all kinds of marine life. Perhaps the very richness of the fauna would be embarrassing to many. My own preference would be Bermuda, probably because I have become familiar with that locality. The fauna there is less rich, of course, but the climate, especially in the spring and early summer months, is more favorable for work and study, being more temperate, and I suppose it is easier and considerably cheaper to go there. Perhaps the social conditions, also, are superior in Bermuda. There would be no lack of materials in either place, and a biological station in either place would be of great value to the progress of science."

A. E. VERRILL.

"I am in hearty sympathy with the attempt to establish a station in the Tortugas, although I think Jamaica would be a better place for a tropical station. One of the most important considerations is accessibility, and in this respect Jamaica has the advantage. Whatever place is selected, some way should be planned to reduce the traveling expenses to a minimum. This would be, I think, an important element in the success of a distant station."

T. H. MORGAN.

It appears to the writer that as the number of persons who will work at a research laboratory is relatively small, richness of fauna and healthfulness of location are probably of more importance than accessibility.

Ideal conditions for a laboratory can not be found in the tropical Atlantic.

The mainland Florida coast is infested with mosquitoes in summer, and its pelagic life is relatively poor. The climatic conditions and healthfulness of the Antilles are not of the best, while their marine fauna is probably inferior to that of the Bahamas or Tortugas. They possess, however, a restricted but interesting land fauna and flora.

The Bahamas lie upon the windward side of the Gulf Stream, and on this account their pelagic life is probably poorer than that of the Tortugas.

The Tortugas are relatively inaccessible, but here we find very pure ocean water, a relatively cool climate, a long period of remarkably calm weather during the late spring and summer, healthfulness due to isolation, and few mosquitoes. The last-named advantage will be appreciated by all who have attempted to live upon the Florida coast or the West Indies in summer.

Were a research laboratory to be established under the auspices of the Carnegie Institution, it might seem advantageous to found it in cooperation with such of our leading universities and colleges as are granting the doctorate for original research. As a tentative proposition, each college might contribute at least $150 annually for each student which it might send to the laboratory, thereby gaining the privilege of nominating students, who, subject to the approval of the Carnegie Institution, should be given free use of all facilities of the laboratory for the purpose of carrying out some definite research work. The traveling expenses of this student should be paid by the laboratory and his research should be published in a suitable manner with illustrations. The proper maintenance of such a laboratory would require an assured annual income of at least $10,000. It would be better to abandon the project than to attempt to carry it out with inadequate equipment and income.

In conclusion, it should be stated that the sole aim of the present writer is to focus the interest of the country upon this project; he desires no official connection with the laboratory, but speaks merely as one of at least forty-three zoologists who are interested in the project. There would appear to be no better medium for a thorough consideration of the subject than the columns of SCIENCE, and it is hoped that sufficient interest will be awakened to evoke an active discussion of the project from all points of view.

The establishment of the Carnegie Institution has, in increasing the possibility for the development of research, placed a corresponding responsibility upon each and every man of science. No laboratory should be founded unless our biologists ardently desire its establishment, and stand ready to avail themselves of its advantages to the fullest extent.

A. G. MAYER.

MUSEUM OF THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

SCIENTIFIC BOOKS.

I. *Experiments on the Effect of Freezing and other low Temperatures upon the Viability of the Bacillus of Typhoid Fever,* with considerations regarding ice as a vehicle of infectious disease.

II. *Statistical Studies on the Seasonal Prevalence of Typhoid Fever in Various Countries and its Relation to Seasonal Tempera-*

ture. By WILLIAM T. SEDGWICK and CHARLES-EDWARD A. WINSLOW. *Memoirs of the American Academy of Arts and Sciences,* August, 1902, Vol. XII., No. V.

In these two papers by Professor Sedgwick and Mr. Winslow—one dealing with their personal experiments on the viability of typhoid bacilli in ice, and the other a statistical study of the determining factors of the seasonal prevalence of typhoid in various countries—we have presented to us an array of interesting data, and especially is this true of the second paper, in which the authors in a painstaking manner have brought together, correlated and made deductions from the statistics of typhoid fever prevalence in many and diverse localities.

Constantly recurring outbreaks of typhoid fever, even where rational precautions seem to have been taken to insure the safety of the public, and the never-failing seasonal rise and fall due to conditions often not fully understood, lend a peculiar interest to all trustworthy investigations bearing on these problems. Bacteriology has already aided in the solution of many obscure problems of disease and its dissemination. The etiology of various diseases has been established beyond all reasonable doubt and much information has been gained in regard to the life histories of many pathogenic bacteria. Yet, in the majority of instances, few, or at best unsatisfactory data have been brought to light in regard to the conditions of the life of these organisms in nature, their habitat outside of the bodies of infected animals and man, and the extent of their distribution. Little is known positively of the conditions of their increase, survival or destruction in nature in the various soils, water, ice, etc., and the effects of variations in temperature, especially those due to seasonal changes on their life and growth. The solution of these problems is of prime importance, and its accomplishment must eventually lead to the establishment of more rational, sure and, it may be assumed, often less irksome precautions for the protection of the individual or community. The outcome of such investigations tends in general toward two principal ends: either to indicate danger where none was supposed to lurk, or to dissipate the fear of a danger which does not exist.

It may well be urged that few, if any, epidemics or even individual cases of typhoid fever occur that could not have been prevented by the intelligent application of knowledge at our disposal, yet the fatal neglect of well-known precautions by those in power, and the criminal negligence or ignorance of those upon whom we are forced to depend for much of our water, ice, milk and food supply, leave us little confidence in the bacterial purity of these in their natural state. In this connection the experiments of the authors on the viability of typhoid bacilli in ice have a special interest even for the general reader, since the facts presented and the conclusions reached are, on the whole, of a reassuring nature. Space will not permit of a review of these experiments in detail. They follow very closely in scope and character those carried out and reported in 1887 by Dr. Prudden. Prudden's work, although done many years ago and under certain conditions which the present investigators have thought fit to eliminate, has been largely confirmed and slightly extended. The chief departure in technique consisted in the substitution of freshly isolated typhoid bacilli for typhoid bacilli that had been for some time cultivated on artificial media, and the gradual lowering of the temperature during the process of cooling and freezing, so as to avoid a too abrupt temperature change, since Bordoni-Uffreduzzi claimed that on account of the rapid changes of temperature in Prudden's experiment and his use of attenuated cultures his results could only have a relative worth, and the results accomplished under natural conditions could not be directly deduced from them.

As a result of the authors' experiments on freezing typhoid bacilli in water and keeping them at 0° C. or below, the conclusion is drawn that less than one per cent. of the typhoid germs present in water can survive fourteen days of freezing, and that during the first half hour of freezing a heavy reduction takes place amounting to perhaps fifty per cent.; after this 'the reduction proceeds pretty regularly as a function of time.'

In this experiment the results of the analysis of control tubes left at the ordinary temperature have not been recorded. This appears to the reviewer a serious defect, as the authors seem to have entirely overlooked the fact that the transfer of organisms from one fluid to another, especially if these fluids be not isotonic, generally results in the destruction of many of the organisms, and that this fact renders it impossible for them to determine the exact part played by the lowered temperature. This defect is somewhat remedied by a comparison with a following independent series of experiments on the effect of temperatures slightly above the freezing point. Their conclusion from this series is largely what our knowledge would lead us to expect, namely, that typhoid bacilli behave in water much as they do in ice: "A large proportion of them are killed by a few minutes' exposure to the unfavorable conditions (cold?); during the next few hours the reduction proceeds *pari passu* with the duration of the experiment; while a few germs persist for some time." The results differ from those obtained by actual freezing in two respects. Freezing for short periods produced varying and uncertain results; ice over twenty-four hours old showed a constant reduction of over ninety per cent. In water the period of uncertainty was much extended; some of the water tubes containing half of their germ contents after a week. Complete sterilization, however, ensued more often than in frozen tubes. "The reduction in water at 10° C. does not seem to be greater than at 20° C." Here, as was surmised above, the temperature probably plays a minor part, and the decrease is largely, no doubt, due to other unfavorable conditions. We do not consider, therefore, that the authors have established in a more definite manner than their predecessors the exact part played in the destruction of bacteria by freezing and low temperatures. Their experiments may indicate in a fair degree the sequences of events when typhoid or other bacilli are suddenly transferred to water from some more favorable environment, but do not establish the behavior of those organisms which may have become accustomed to such new surroundings.

Our attention has also been attracted by a statement of the authors, that bacteria settling to the bottom 'may soon perish for want of air.' This statement must be born of pure hypothesis, as cultures of typhoid bacilli will in fact live for years anaerobically.

The result of experiments on the viability of typhoid bacilli in sterilized earth at various temperatures was the following: Typhoid bacilli in dry earth behave just as in water and ice. They die out rapidly at first, and their numbers are progressively reduced as the treatment is prolonged. A fraction of one per cent. persists for some time. Cold alone does not materially effect the reduction of typhoid germs in dry earth. In moist earth the destruction of the bacteria is much less rapid; at times when food supply is plentiful they appear to hold their own.

In another set of experiments it was found that sedimentation did not produce marked or constant effects on colon and typhoid bacilli in water during as short a period as twenty-four hours. Ice, however, formed on the surface of a quiet body of water contained only about ten per cent. of the bacteria present in the water. This difference, they conclude in agreement with various observers, is due to the physical exclusion by the process of crystallization, and not to any germicidal action, as the temperature of the ice can only differ from that of the adjacent water in a very slight degree. There are two forces at work: low temperature killing off the germs in ice and water nearly equally, and the crystallizing process extruding germs from the ice into the water.

The general conclusions and applications of the results of the experiments as given by the authors may be summed up somewhat as follows: The main factor determining the reduction of germs in water is *time*—the time during which the various purifying forces are left to act. Epidemiology shows clearly that disease follows most often a direct, quick transfer of infectious material from patient to victim; and if storage of water for some months could be insured, many sanitarians would consider such storage a sufficient purification. In ice this condition is realized—

a forced storage of at least weeks and at best of many months. In natural ice, besides the action of cold, there is another purifying influence, the exclusion of ninety per cent. of the germs by the act of freezing. Under natural conditions the pathogenic germs present in the most highly polluted stream are comparatively few. Of these few, one tenth of one per cent. may be present in ice derived therefrom. Even these scattered individuals are weakened by their sojourn under unfavorable conditions, so that it is doubtful if they could produce many, if any, cases of typhoid fever. With artificial ice the case is different, for such ice is made from water frozen solid and, as a rule, quickly consumed. Such ice, therefore, if made from impure water may contain the germs of infectious disease, and, being used quickly after its manufacture, may be a menace to the public health. With natural ice also there must always remain an element of doubt. Polluted ice might be cut at once, and served within a week or two, and sufficient disease germs might persist to cause infection. Yet the authors think such an instance must be very exceptional; and the general result of human experience, the absence of epidemics of typhoid fever traced conclusively to ice; the fact that cities like New York, and Lowell and Lawrence, Massachusetts, have used ice of polluted streams and have yet maintained low death rates from typhoid fever, all tend to support the conclusion at which they have arrived, namely, that natural ice can rarely be a vehicle of the infectious agent of typhoid fever.

Such results and conclusions as these, coming from this high authority, confirming in essential details the work of other investigators, as well as extending our knowledge of this important subject, are somewhat reassuring in regard to the use of ice.

This is especially true from the standpoint of the general sanitarian, who, accepting these data, may look upon stored ice as a neglectable sanitary quantity, and to the statistician in his estimates of usual sources of disease; but in the opinion of the reviewer, the individual facing the element of doubt in the purity of ice, and especially as ice is so universally handled just prior to using, should not be led by the purity of the ice in general to abate any reasonable precautions for his own protection. It has been too much our habit, as many fatal epidemics bear witness, to take chances in matters sanitary, and to bend to expediency and personal or public convenience rather than to strive for the ideal.

Such papers are apt to convey the impression to the lay and even, it is to be feared, to the official mind, that sanitary precautions may be neglected in the use of ice. Let us urge, however, that it is small comfort to the individual suffering from typhoid fever contracted from polluted ice to be told that ninety-nine per cent. of his friends use ice with impunity.

In the studies of statistics on the seasonal prevalence of typhoid fever in various countries and its relation to seasonal temperature, the authors review fully the literature on the seasonal prevalence of typhoid fever, setting forth at some length the various data as to the time of maximal and minimal occurrence, and the hypotheses that have been advanced in explanation of those variations. Chief among these, historically at least, as is so well known, is the view, supported by Pettenkoffer and his school, that there is a relation between the variations in level of the ground water and variations in the prevalence of typhoid—typhoid cases being abundant when the ground water is lowest. The only plausible explanation of the connection, however, between ground water and typhoid fever on the basis of the germ theory is, in the opinion of the writers, that furnished by Liebermeister, who in 1860 suggested that the phenomena might simply be due to the concentration of soil impurities in the wells at the time of low water, and their transmission in unusually large doses to those who drank therefrom. Dr. Baker in this country advocates this idea with modification, and a recognition of the fact that a well in use drains a wider area when the ground water is low and is thus liable to pollution from more distant sources.

Whatever the explanation, it seems to be true that at Munich in the period studied by

Pettenkoffer and his followers, a real relation did exist between ground water level and typhoid. In no other case, so far as the authors are aware, has the possibility of the influence of temperature been excluded. This varies inversely with the ground water and directly as typhoid fever, and the seasonal curve in many places may be more plausibly explained by this than by variations in ground water.

Murchison was the first forcibly to call attention to the importance of the temperature factor. Plausible as the explanation appears, it has not gained wide acceptance, and, as stated by the authors, has been practically ignored in Germany. In summing up this subject, they say: "Although most observers have noted a characteristic seasonal distribution of typhoid fever, others, including some of those who have written most recently, have denied the existence of such variations. Of those who realized that the variations did exist, a few sought an explanation in the factor of temperature. Their views did not, however, gain acceptance, as the evidence furnished was insufficient; and the common view among medical men and sanitarians has been that the fall maximum of typhoid fever was an unexplained phenomenon."

Sedgwick and Winslow have attempted, by careful collection and comparison of statistics, to see whether the relation shown by Murchison, Liebermeister and Davidson for a few places could be demonstrated for a wider field. They have, therefore, brought together statistics of the monthly variation in temperature and the prevalence of typhoid fever for thirty communities. These include the states of New York and Massachusetts, the District of Columbia, Baltimore, Boston, Charleston, Chicago, Cincinnati, Denver, Mobile, Newark, New Orleans, New York, Oakland, Philadelphia, St. Paul and San Francisco in the United States; the city of Montreal in Canada; the cities of Berlin, Dresden, Leipsic, London, Munich, Paris and Vienna in Europe; the Empire of Japan, and the British Army in India in Asia; and the cities of Buenos Ayres and Santiago de Chile in South America. Four continents and both hemispheres are thus represented, and a wide range of climate.

Monthly values for temperature and typhoid prevalence have also been plotted on appended plates in order to show graphically the relation of the two curves.

An examination of the plotted curves shows a remarkable parallelism between monthly variations in temperature and typhoid prevalence. Of the thirty communities considered, eighteen show the parallelism to be almost perfect. Three other typhoid curves, those for India, for Charleston and for New Orleans, rise with the temperature in spring, and fall with it in autumn, but show a temporary decrease in the disease during the time of greatest heat. In these twenty-one cases the connection between the two factors seems too close not to indicate a vital relation. In northern cities the course of typhoid is acute; in cities with more and more equable temperatures the curve is progressively flattened.

In the northern localities the maximum occurs in September and October; in southern cities with a milder winter it comes in August or July. In the two cities of the southern hemisphere (Buenos Ayres and Santiago) the curves of both typhoid fever and temperature are exactly reversed. In the case of the tropical and subtropical regions—India, Charleston, New Orleans—it appears that the rise with the temperature, after beginning in the usual fashion, is checked by some other factor, perhaps strong sunlight or extreme dryness.

In the case of the nine cities which show more or less irregular curves, the authors call attention to a factor much neglected by previous students of seasonal variations; *i. e.*, the necessity of discriminating between sharp epidemic outbreaks and the slow succession of isolated cases which characterize that condition usually known as 'endemic.' They lay stress upon a distinction, vital to epidemiologists, which must be drawn between infection which reaches a number of persons at once through a single medium, as water or milk, and the slower, more complex process by which a disease passes from person to person; the path of the contagious material being

different in each individual instance. The term 'prosodemic' has been used to describe this form of infection. Such prosodemic disease, they rightly consider, should be mainly considered in the analysis of data bearing upon seasonal prevalence. An epidemic must always be looked upon as a perturbing element. Curves based upon a small number of cases will always be liable to show irregularities due to single epidemics, and this is the explanation in four of the nine cities of their irregular seasonal curves. In the case of the other cities, the curves of which are based on ample statistics—Chicago, Cincinnati, Newark, Paris and Philadelphia—the curves show secondary maxima—one in December or January, the other between March and May. These five cities draw their supply from surface sources liable to gross pollution. Heavy autumn rains and spring floods carry into these surface water supplies a larger amount of pollution than reaches them at any other time.

The authors generalize: Winter and spring epidemics are characteristic of those cities whose water supply is most subject to pollution; they are absent from communities which use filtered water or water obtained from adequately protected watersheds. They conclude that wherever a sufficient number of cases have been considered a direct relation between typhoid fever and temperature appears to be general and invariable.

The probable mechanism of the seasonal changes, according to their conception, may be given in their own words: "The bacteriology and the etiology of typhoid fever both indicate that its causal agents can not be abundant in the environment during the colder season of the year. The germs of the disease are carried over the winter in the bodies of a few patients and perhaps in vaults or other deposits of organic matter, where they are protected from the severity of the season. The number of persons who receive infection from the discharge of these winter cases will depend, other things being equal, upon the length of time for which the bacteria cast in these discharges into the environment remain alive and virulent. The length of the period during which the microbes live depends largely upon the general temperature; as the season grows milder, more and more of each crop of germs sent at random into the outer world will survive long enough to gain entry to a human being and bear fruit. The process will be cumulative. Each case will cause more secondary cases, and each of the latter will have a still more extensive opportunity for widespread damage. In our opinion the most reasonable explanation of the seasonal variations of typhoid fever is a direct effect of temperature upon the persistence in nature of germs which proceed from previous victims of disease."

This paper on the seasonal prevalence of typhoid fever merits a careful study in the original, and, in the main, one familiar with this subject must be impressed with the justness of the conclusions based upon the data there brought together.

Philip Hanson Hiss.

SCIENTIFIC JOURNALS AND ARTICLES.

The April number of the *Transactions* of the American Mathematical Society contains the following papers: 'The approximate determination of the form of Maclaurin's spheroid,' by G. H. Darwin; 'On twisted cubic curves that have a directrix,' by H. S. White; 'Ueber Curvenintegrale im m-dimensionalen Raum,' by L. Heffter; 'The generalized Beltrami problem concerning geodesic representation,' by E. Kasner; 'On the holomorph of a cyclic group,' by G. A. Miller; 'Quadric surfaces in hyperbolic space,' by J. L. Coolidge; 'Ueber die Reducibilität der reellen Gruppen linearer homogener Substitutionen,' by A. Loewy; 'On the possibility of differentiating term by term the development for an arbitrary function of one real variable in terms of Bessel functions,' by W. B. Ford; 'On a certain congruence associated with a given ruled surface,' by E. J. Wilczynski; 'On the class number of the cyclotomic number field $k(e^{2\pi i/p^n})$,' by J. Westlund.

The May number of the *Bulletin* of the American Mathematical Society contains: Report of the February meeting of the

American Mathematical Society, by F. N. Cole; 'On the foundations of mathematics' (presidential address), by E. H. Moore; 'Concerning the axiom of infinity and mathematical induction,' by C. J. Keyser; 'A German calculus for engineers' (review of Fricke's 'Calculus'), by E. R. Hedrick; Notes; and New Publications.

The current number of the *American Journal of Mathematics* contains the following articles:

Edward Kasner: 'The Double-Six Configuration Connected with the Cubic Surface, and a Related Group of Cremona Transformations.'

Saul Epsteen: 'Untersuchungen über lineare Differentialgleichungen 4. Ordnung und die zugehörigen Gruppen.'

A. N. Whitehead: 'The Logic of Relations, Logical Substitution Groups and Cardinal Numbers.'

John Wesley Young: 'On a Certain Group of Isomorphisms.'

F. E. Ross: 'On Differential Equations Belonging to a Ternary Linearoid Group.'

The April Number of the *Biological Bulletin,* Volume IV., No. 5, contains the following articles:

Edmund B. Wilson: 'Notes on Merogony and Regeneration in *Renilla.*'

Carl H. Eigenmann and Clarence Kennedy: 'Variation Notes.'

Walter S. Sutton: 'The Chromosomes in Heredity.'

Henry Leslie Osborn: 'On *Phyllodistomum americanum* (n. sp.); a New Bladder Distome from *Amblystoma punctatum.*'

Thos H. Montgomery: 'The Heterotypic Maturation Mitosis in Amphibia and it General Significance.'

Bashford Dean: 'An Outline of the Development of a Chimæroid.'

SOCIETIES AND ACADEMIES.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

It is a pleasure to record that the Academy of Science of St. Louis, which has thus far in its existence met as a tenant or guest, is now in possession of a home of its own in which it will probably be installed before the end of the current year.

Some months since, Mrs. Eliza McMillan and her son, Mr. William Northrop McMillan, offered to purchase for the academy a piece of property on Olive Street between Spring and Vandeventer avenues, in what is now coming to be the central district of St. Louis, as a memorial to the late William McMillan, who, at the time of his death, was a member of the academy. The transfer has now been effected and was announced by the council at the regular academy meeting of April 6, on which occasion the following resolutions were unanimously adopted:

"Resolved, That the members of the Academy of Science of St. Louis most gratefully accept from Mrs. Eliza McMillan and Mr. William N. McMillan, the gift of a permanent home for the academy. We feel that this generous donation will infuse new life into the institution and will insure its future usefulness. We pledge ourselves to use every effort to make it worthy of the confidence thus shown by the donors and to maintain the object of its founders, as expressed in the Act of Incorporation—'the advancement of science and the establishment in St. Louis of a museum and library for the illustration and study of its various branches.'

"Resolved by the members of the Academy of Science of St. Louis, that the property conveyed on the 18th day of March, 1903, by Edgar R. Hoadley and Luvinia L. Hoadley to the Academy of Science of St. Louis, which property is the gift of Mrs. Eliza McMillan and William N. McMillan, shall not be mortgaged or encumbered so long as it remains the property of the Academy of Science.

"Resolved, further, that the property shall not be sold except by a two thirds vote of the members of the Academy of Science of St. Louis by letter-ballot in the manner prescribed by the council, and that when sold, the proceeds of the sale, or as much thereof as may be necessary, shall be used to provide a suitable location and building for the uses of the Academy of Science."

In introducing the foregoing resolutions, Professor Nipher, long a member of the academy and for a considerable period its president, said:

"I can not allow this occasion to pass without calling attention to the great significance of the announcement which has been made this evening.

"Ever since the academy was organized, in

March, 1856, its work has been done under the most discouraging circumstances. It has never had a home. Its meetings have been held in the meeting-room of the Board of Education, at a medical college, at Washington University, and in the rooms of the Missouri Historical Society. It has never had its own home, where it might make its valuable library and its collections of real service to the citizens of our city. During all these years of its existence the academy has been collecting a library of scientific publications, in exchange with similar societies in all parts of the world. Our published *Transactions* have gone to every civilized land. We have certainly had the outward semblance of great scientific activity. There is no local academy of science in this country which can present a more creditable record of published work. Even during the Civil War, when almost every educational interest suffered, a few working investigators, aided by others who gave such support as they could give, continued to produce before this body their contributions to knowledge, and to publish them to the world in the *Transactions* of the academy.

"During all of this time these pioneers have been hoping to see this day. Year after year the president's annual report has called attention to the vital necessity of a fixed abiding-place which we could own and control. Without this we could never hope to establish a public museum of science, or to avail ourselves of our precious library.

"And now the first great advance has been made. This gift to the cause we have been striving to uphold could not have been more opportune. These enlightened patrons of higher learning have seen their opportunity, and they have volunteered their aid. The manner in which they have bestowed their bounty makes it doubly valuable and effective. They have made it impossible for us to honor them by any act within our power. They have become one with us in the cause which we have all labored to advance. May we not hope that they will permit us to enroll their names in our membership as patrons of the academy?

"And this gift brings with it new obligations for us. We should now seek to establish an endowment fund, which will enable us to make our valuable collections of books and specimens fully available to the public. During the World's Fair we shall be under examination. Learned men from this and other lands will come among us. The great public will be here. The location of our new home is such that we can not fail to attract the attention of vast numbers of our visitors. We should not only have a museum and library which will be an honor to our city, but it should be open to all. We wish to show that we have here, among the permanent institutions of our city, an academy of science which is dedicated to the advancement of human learning, and to the diffusion of knowledge among men. In this way we shall fittingly carry out the work which Mrs. William McMillan and her son, Mr. William Northrop McMillan, have so nobly begun."

On nomination of the council, Mrs. McMillan and Mr. W. N. McMillan were elected patrons of the academy.

WM. TRELEASE,
Recording Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 369th meeting was held Saturday, March 21.

T. S. Palmer told of 'The Preservation of Pelican Island as a Breeding Ground for Birds.' He said that this islet situated in Indian River, Florida, was the only place on the east coast where the brown pelican bred, and that the Audubon Society had for some time been endeavoring to secure it. It had been found that the necessary legal proceedings would require some two years' time and that the spot might, after all, be secured by another party; at the request of the Secretary of Agriculture it had been made a government reservation, one of the very few cases on record where such a step had been taken to preserve the birds.

Walter H. Evans drew attention to some deficiencies in 'The International Catalogue of Scientific Literature,' stating that in examining the volume containing the bibliography of bacteriology he had found that only a very small portion of such papers published in the United States had been recorded. He cited a number of journals whose articles had been entirely or partially omitted, and said that, on the other hand, papers were included in the catalogue that could only by courtesy be considered as bacteriological in their nature.

Vernon Bailey spoke of 'The Desert Life of Western Texas,' illustrating his remarks with views showing the characteristic features

of the flora and fauna of the region; and Paul Bartsch presented some 'Notes of the Herons of the District of Columbia.' He described at some length a colony of night herons, showing various views of the nests with eggs and young in various stages, and also exhibited some pictures of young blue herons and of the great white egret, expressing his regret that these birds had subsequently been nearly all killed by hunters.

F. A. Lucas.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 140th meeting of the society, held in the assembly hall of the Cosmos Club, Wednesday evening, March 11, 1903, the following program was presented:

Mr. A. J. Collier, 'Coal-bearing Series of the Yukon.'

About 9,000 tons of coal have been mined along the Yukon since 1897. Above the Tanana the coal occurs in small Eocene basins surrounded by older rocks. Below the Tanana a coal-bearing formation, called the Nulato sandstone, is exposed almost continuously for 400 miles. From the lowest beds of this series cycads of Jurassic and Lower Cretaceous aspect were obtained in the same matrix with dicotyledons of Upper Cretaceous aspect. In other places Upper Cretaceous plants and invertebrates and Eocene plants were obtained, but the horizons could not be differentiated stratigraphically or lithologically, and continuous sedimentation from the Middle Cretaceous to the Upper Eocene is suggested. The Nation River coal bed on the upper Yukon may be either Permian or Eocene overthrust by Permian limestones.

Mr. Frank C. Calkins, 'Soils of the Wheat Lands of Washington.'

The soil covering the higher portions of the Columbia plains has generally been considered to be residuary, and derived from the underlying Miocene basalt. Recent observations, however, have led the author to believe that this soil is an eolian deposit. The argument for the eolian hypothesis is based on the physical and chemical properties of the soil and the complete lack of transition between it and the underlying rock. The wind-blown material is supposed to come from the soft volcanic sediments that overlie the basalt in the southern portion of the Columbia plains.

Dr. H. S. Washington, 'The Calculation of Center-points in the Quantitative Classification of Igneous Rocks.'

After briefly explaining the main features of the new classification (see Science, February 27, 1903, pp. 341 et seq.), the speaker showed that, as the classification is strictly quantitative, the theoretical chemical and normative composition of the center-point of any given classificatory division could be calculated mathematically. This is accomplished by forming equations expressing the definition of the center-point of each successive classificatory division, from the solution of which the norm is obtained. From this the chemical composition follows. The method will be explained at length in a publication which is soon to appear.

The result of a calculation of the average igneous rock, based on nearly 2,000 reliable analyses, taken from a collection which has been made by the speaker, was also communicated. It was shown that this latest estimate approximates very closely to those of Clarke and Harker.

Professor Edward Mathews, 'The Practical Working of the Quantitative Classification.'

The author presented the salient features of the new classification as indicated by the averaging of some 500 analyses according to subrangs, rangs, orders and classes. The figures seem to indicate that the new rules are applicable with little or no subjectivity, but that little can be told with certainty regarding the classificatory position from an inspection of the chemical analysis.

The author commended the simplicity of the basal conceptions and the resulting simplicity of definitions; the suggestion of new lines of investigation developed by the classification; and the mnemonic features of the nomenclatures. He, however, criticized the choice of order names and roots, the subordination of texture, the fact that the literature would be deprived of its usefulness and the extreme emphasis likely to be placed on chemical analyses of single specimens.

The conclusion drawn by the author was on the whole favorable to the new scheme and the thought was expressed that the new classification more or less modified would bear the same relation to the present nomenclature as the scientific system in botany does to the popular plant names.

W. C. MENDENHALL,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 563d regular meeting was held February 14, 1903.

Rev. J. G. Hagen, S.J., of Georgetown University, spoke of 'A Peculiar Type of Temporary Stars,' the variation of which is so short in duration that it can not be confirmed by an independent second observer. The speaker enumerated and explained five instances of this character, and showed that the authorities in each case were of such weight that the existence of this type can no longer be doubted. The five instances contained two that had been known for many years, but had been accepted with great reserve. Another was published a few months ago; one was taken from unpublished manuscripts of the late E. Heis, and the last was an observation of Christoph Scheiner, S.J., in 1612, which has never been fully studied or understood. The latter especially deserved to be entered in the catalogues of variables stars as well as any other temporary star.

The next paper, by Mr. C. W. Waidner, of the Bureau of Standards, was 'A Discussion of the Practical Methods of Measuring Temperature and the Accuracy attainable by these Methods.' The paper contained a brief outline of the present state of mercurial thermometry in the range $-35°$ C. to $+550°$ C., and of the development of suitable kinds of glass for thermometric purposes; some applications of platinum thermometers, thermoelectric and specific heat pyrometers, to the measurement of temperatures, the accuracy and limitations of each of these methods; the estimation of temperatures beyond the range of these methods, *e. g.*, that of the electric arc, the Nernst filaments, etc., by extrapolation of Stefans's and Wiens's radiation laws.

CHARLES K. WEAD,
Secretary.

AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION.

THE forty-third regular meeting of the section was held at the 'Tech. Union,' Massachusetts Institute of Technology, Boston, Tuesday, March 31, 8 P.M., President A. H. Gill in the chair. About 45 members were present.

Professor Charles F. Mabery, of the Case School of Applied Science, Cleveland, Ohio, presented a paper, entitled 'A Résumé of the Composition of Petroleum,' in which, after a historical introduction of the subject, the lecturer stated that the subject had occupied his attention during the last twenty years, during the last ten of which, with the aid of grants by the American Academy of Arts and Sciences from the C. M. Warren Fund, and the facilities of the chemical laboratories of the Case School, he had been able to employ a corps of assistants that has made possible the vast amount of labor necessary in distilling, analyzing and otherwise identifying the constituents, distilling below 350 degrees to 450 degrees in petroleum from the field in Pennsylvania, Ohio, Indiana, Texas, California, Japan and South America. As a result of this work, it appears that the portions of petroleum distilling below the limits mentioned are composed of the series

$$C_nH_{2n+2},\ C_nH_{2n},\ C_nH_{2n-2},\ C_nH_{2n-4}.$$

The sandstone oils, such as the Pennsylvania deposits, contain the continuous series

$$C_nH_{2n+2}, \quad \text{up to} \quad C_{28}H_{58},$$

and doubtless higher, but this is the limit of possible molecular weight determinations at present. Ohio Trenton limestone oil contains members of this series up to and including $C_{11}H_{24}$, and also the so-called solid paraffine hydrocarbons; but the series

$$C_nH_{2n},\ C_nH_{2n-2},\ C_nH_{2n-4}$$

form the greater portion of the Ohio oil. Associated with the solid paraffine hydrocarbons are liquid bodies of the series C_nH_{2n} and C_nH_{2n-2} in smaller proportions.

Petroleum from the corniferous limestone in Canada resembles Ohio petroleum in containing the series C_nH_{2n+2}, up to $C_{11}H_{22}$, but this oil contains larger portions of the heavier series

$$C_nH_{2n},\ C_nH_{2n-2},\ C_nH_{2n-4},$$

which explains its higher specific gravity. In Texas and California petroleum the series $C_n H_{2n+2}$ does not appear, and the main body of the oil is composed of the series poorer in hydrogen.

As a result of the above investigations, petroleum can be defined as a mixture of a few series of hydrocarbons, and products from different fields differ only in the proportions of the series contained in them. A great field for chemical research yet remains in ascertaining the structure of the series described above, and of the so-called asphaltic hydrocarbons, which can not be distilled without decomposition. The composition of the oil from different fields should have an important bearing on the question of the formation of petroleum, and there is a field for the chemical geologist to study, more intimately than has yet been done, the occurrence of petroleum in connection with its composition.

Arthur M. Comey,
Secretary.

IOWA ACADEMY OF SCIENCES.

The seventeenth annual meeting of the Iowa Academy of Sciences was held in Des Moines, December 30 and 31, 1902.

The following papers were presented at the sessions:

'Living Plants as Geological Factors,' by B. Shimek. This was a discussion of the influence of living plants in checking erosion and thus overcoming in part the destructive action of running water. Their constructive effect was also considered, and examples were given of their influence in the formation of new deposits by serving as an anchorage for materials brought from a distance. Plants are believed to have been important factors in the formation of the loess. There is much evidence that the loess was deposited by the wind upon plant covered land surfaces.

'The Solar Surface During the Past Twelve Years,' by David E. Hadden. This paper was a review of a series of sunspot observations made by the writer from 1890 to 1902. Daily observations were taken, usually about noon in the autumn and winter and between seven and eight o'clock in the morning during the warmer season. During the period under review about 1,750 groups were observed on the visible disk, the greatest number, 285, being registered in 1893, and the least number, 18, in 1901.

'The Origin of the Lignites of North Dakota,' by F. A. Wilder. All the workable lignite beds of North Dakota are regarded as being of Laramie age. The beds of this age consist mainly of clays which are not fissile or shale-like, and the lignite is interstratified with these clays. The lignite is believed to have been formed in fresh-water lakes which originated during the Rocky Mountain uplift and were fed by streams coming from the west. These rapidly flowing streams would carry much timber and deposit it in the lakes, thus giving rise to the vegetable accumulations which produced the lignite.

Other papers presented were the following:

H. E. Summers: Presidential address, 'Some Problems of Heredity and Evolution.'

L. H. Pammel: 'Some Ecological Notes on the Vegetation of the Uintah Mountains.'

Frank L. Almy: 'Some Observations upon the Action of Coherers when Subjected to Direct Electromotive Force.'

Howard E. Simpson: 'The Accretion of Flood Plains by Means of Sand Bars.'

B. H. Bailey: 'The Duck Hawk (*Falco peregrinus anatum*) in Iowa.'

H. W. Norris: 'The Membrane Bones in the Skull of a Young Amphiuma.'

A. N. Cook: 'The Preparation of Phenylether.'

A. N. Cook and W. J. Morgan: 'The Sioux City Water Supply.'

C. R. Keyes: 'Significance of the Occurrence of Minute Quantities of Metallic Minerals in Rocks.'

C. R. Keyes: 'Genesis of Certain Cherts.'

J. B. Weems and Alice W. Hess: 'The Chemical Composition of Nuts as Food.'

J. B. Weems and E. C. Myers: 'The Preparation of Ammonia-free Water for Water Analysis.'

T. E. SAVAGE: 'The Toledo Lobe of Iowan Drift.'

T. J. and M. F. L. FITZPATRICK: 'The Scrophulariaceæ of Iowa.'

L. H. FORD: 'Smallpox in the Public Schools.'

'Notes from the Chemical Laboratory of Cornell College.'

W. E. SANDERS: 'A Study in Psychopathic Heredity.'

The membership of the academy was increased by the addition of the following fellows: T. C. Frye, D. W. Morehouse, H. C. Price and B. C. Lanphear; the new associate members are Lucy M. Cavanagh, Harriet Clearman, Fred Seaver, A. M. Allen and R. E. Buchanan.

The newly elected officers are:

President—B. Fink.
First Vice-President—S. W. Beyer.
Second Vice-President—Maurice Ricker.
Secretary—A. G. Leonard.
Treasurer—H. W. Norris.

A. G. LEONARD,
Secretary.

THE KELVIN PHYSICAL CLUB OF THE UNIVERSITY OF PENNSYLVANIA.

THE club met on Saturday, February 28, in the Randal Morgan Physical Laboratory and listened to a paper by Mr. Homer M. Derr, on 'Chromatic Interference with Thin Section of Doubly Refracting Crystals in Polarized Light.' The paper contained in brief the theory of the colors of thin rock sections as seen through a polarizing microscope and discussed the practicability of using the same as a means of analysis when chemical action was insufficient to detect certain minerals.

Mr. Derr is constructing a table of the colors up to the fourth order of different minerals with varying thicknesses for qualitative analysis in petrology.

At a meeting of the club on March 7, a paper was presented by Mr. J. Frank Meyer, which reviewed the history of electric convection from the beginning to its present culmination in the dispute between Cremieu and Prender. There was a full attendance at the meeting.

JOS. H. HART,
Secretary.

DISCUSSION AND CORRESPONDENCE.

WILL-MAKING.

TO THE EDITOR OF SCIENCE: Professor Chamberlain's suggestion in SCIENCE, March 6, page 391, that wills should be probated during the lifetime of the testator, has been frequently made to legislatures and just as frequently rejected. It was one of the matters considered and rejected by the judges' committee in the recent revision of Colorado probate law.

In the first place, the suggestion assumes that will disputes and the so-called 'breaking of wills' are matters of very common occurrence, which, though a popular supposition, is to those whose business is the administration of probate law known to be entirely incorrect. An attack upon a will is the exception, and a successful attack even vastly rarer. The few cases of rejected wills are published far and wide in the newspapers, while the thousands admitted to probate without contest never are heard of by the public, creating an erroneous impression. I have had personal knowledge of hundreds of wills, and while I have heard of such instances and read of them in the newspapers and judicial reports, yet have never personally known of refusal to admit a will to probate, except in a few cases in which the paper was not attested by the proper number of witnesses. During the last year I have been constantly in communication and conference with other judges having probate jurisdiction and with probate lawyers, and have found that to be the common experience. If men fail to have their wills witnessed by the statutory number of witnesses, they would be as apt to fail to probate them during lifetime, as it would be only another means of having them witnessed. Then, too, the tendency would be to discourage wills by making the process more complicated, and making it impossible in cases where the testator is far from court and physically unable to travel, or when death is imminent and time, therefore, limited. Furthermore, the question of its construction and effect could not be properly and safely determined by the court in a purely *ex parte* proceeding, and if it could, in many cases a decree thus drawn without a knowledge of the future would itself often come up for construction later on.

It is doubtful, in any case, whether it is advisable to override a fundamental principle of civilized jurisprudence, to wit, that 'every man should have his day in court.' Fraud would be much easier under such a system. While in a mental condition unfitting him to do business but not manifesting itself to the court on casual inspection, or under undue influence through fear or other causes, a man is brought by beneficiaries under his will before a probate court and his will admitted to probate. Then his life is taken by the beneficiaries. No matter what facts they might be able absolutely to prove, the mouths of his heirs, who have never had a chance to be heard, are closed. They can not attack the probate, so the will stands and the property goes where neither the law nor the testator wished it to go. On the whole, the suggestion seems a dangerous one. The Colorado probate revision committee considered the remedy suggested much more dangerous than the disease.

Junius Henderson.

CURRENT NOTES ON PHYSIOGRAPHY.

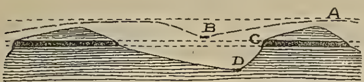
SNAKE RIVER LAVA PLAINS.

Russell's latest report on the 'Geology and Water Resources of the Snake River Plains of Idaho' (U. S. Geol. Survey, Bull. 199, 1902) is as full of physiographic matter as many of his earlier reports have been. The plains are in southern Idaho, measuring 350 miles in length by from 50 to 75 miles in width; they occupy a broad depression between enclosing mountains, and are built of extensive basaltic lava flows often overlying Tertiary 'lake beds.' The lavas have been ascribed to fissure eruptions, but Russell follows Lindgren in referring them to volcanic vents within the area of the plains or in the neighboring mountains. Several lava streams issue from the mountain valleys; one of them was so liquid when erupted that after flowing fully 50 miles as a stream from one to three miles wide it could still spread widely on the plains. The vents within the plains are either cinder cones of the ordinary type, from which very fresh flows are traceable, or low broad lava cones of gentle slope, 8 to 10 miles in basal diameter and only 200 or 300 feet high. The more liquid flows thin out gradually on the plains to feather edges; others are limited by ragged scarps 20 or 30 feet high. The border of the plains contours around the enclosing mountains, converting valleys into bays, spurs into headlands and outlying knobs into 'steptoes' (p. 34). The most remarkable examples of the latter forms are two dissected rhyolitic volcanoes, of which the highest, Big Butte, rises 2,350 feet over the plains. In one district of fresh flows, a road between two towns forty miles apart follows the slight depression between the edge of the lava and the mountain slope, turning into every valley and rounding every spur, and thus doubling the straight-line distance, rather than climb the hills or cross the bare lava. Most of the plains are covered with a soil largely æolian. Extensive gravel fans are formed where certain streams have had to aggrade their courses on passing from mountain valleys of strong slope to the level plains; here Russell unfortunately introduces the term 'upgrading streams' (p. 133), although he has used 'aggrading' in his 'Rivers of North America.' Some fans antedate the lavas and stretch under them, favoring the passage of ground water beneath the plains. Snake River and its larger branches trench the plain where it is lava-covered, and produce a mature topography in the unprotected lake beds further west. Special account is given of short canyons eroded by springs along the border of Snake River canyon.

THE FAN OF LANNEMEZAN.

The great fan or 'plateau' of Lannemezan, with a radius of more than 100 kilom., at the foot of the Pyrenees in southwestern France, together with its smaller neighbors on the west, the fans of Orignac and Ger, have long been noted for the unsymmetrical form of their radial consequent valleys, whose side slopes are with few exceptions steeper on the right than on the left of the stream. It has frequently been suggested that this systematically unsymmetrical habit might be due to the deflective force arising from the earth's rotation, and the suggestion has as often been doubted because the deflective force must be so small. A thorough study of the problem

by Marchand and Fabre ('Les érosions torrentielles et subaëriennes sur les plateux des hautes Pyrénées,' *C.-R. du Congrès des Soc. Sci. en 1899*, Paris, 1900) indicates that the doubt is well founded and refers the asymmetrical form to the action of the northwesterly rain-bringing winds and the associated action of lateral rills and radial torrents on the weaker and stronger strata of the fans. A determining factor is found in a compact clayey layer at about mid-height on the valley side between weaker, sandier deposits below and above. So long as the valleys are worn only in the weak upper layer, their cross-section shows a gentle slope on the side *AB* that is attacked by the northwest winds. But when the valleys are worn through the resistant clays to the weak under layers, the lower slopes, *CD*, on the wind-attacked side



are steepened, although the earlier relation may still obtain on the higher slopes; and it is in this condition that most of the valleys are found. The explanation of the process by which this change of form is brought about is not immediately convincing and is too detailed for abstract here.

THE QUEENSLAND COAST.

A 'Preliminary note on the Geology of the Queensland Coast * * * ' of northeastern Australia, by E. C. Andrews (*Proc. Linnean Soc. N. S. W.*, 1902, pt. 2, pp. 145–185), presents in modern form—although not in the best arrangement—a highly appreciative account of the mainland and islands back of the Great Barrier reef. The terminology of Gulliver's essay on 'Shore line topography' is largely used. The continental shelf on whose outer edge the great reef is built at from fifteen to one hundred miles from the mainland is described a lowland and platform of subaerial and marine denudation and deposition, moderately submerged in Pleistocene time. The shelf continues south of the reef, its outer slope always rising from great depths. Numerous monadnock-like islands of continental rocks (granite, etc.), often rugged and mountainous, rise from the shelf as far out as twenty miles from the mainland. The islands and the mainland are commonly bordered with low, sandy coastal plains and mangrove swamps, up to twenty miles in breadth, exhibiting consequent drainage; and from this a slight modern elevation is inferred. Some of the islands are made of sand only, bearing high dunes. Many of the islands are tied together or to the mainland by tombolos, bays are more or less enclosed by bars, and rivers are deflected scores of miles northward by the growth of heavy sand reefs under the action of currents and waves driven by the southeast trade wind. The monadnocks increase in number on the mainland, until the highest part of the back country gains the appearance of an undulating tableland, up to 4,000 feet in altitude. This is described as showing late-mature Tertiary valleys eroded 1,000 feet or more beneath a Cretaceous peneplain, whose remnants are often capped with basalt outliers resting on auriferous gravels. About Pliocene time the whole country was uplifted so that cañons 3,000 feet or more in depth are now cut in the Tertiary valley floors; the streams plunge down falls 1,000 feet in height from the as-yet-uncut valley floors into the canyon heads. W. M. Davis.

RECENT ZOOPALEONTOLOGY.

COMPARISON OF THE EUROPEAN AND AMERICAN EOCENE HORSES.

A paper published in March, 1901, which should have been reviewed earlier is by Professor Charles Depéret, of Lyons, entitled 'Revision des Formes Européennes de la Famille des Hyracothéridés.' It consists of the study and redefinition of all the types of Eocene horses described during the last century in France and England before the ancestral relationship of any of these animals to the horses was appreciated. Since the recognition of the Eocene horses in America by Marsh, it has become evident that they are very closely allied, if not identical in stages of evolution with contemporary forms in Europe. As a result of a close analysis, which is accompan-

ied by admirable figures, Depéret points out that *Eohippus* Marsh from our Wasatch (p. 222) is closely similar to *Hyracotherium* Owen and to *Pachynolophus* Lemoine from the Suessonian; that *Protorohippus* Wortman from our Wind River is closely similar to *Propalæotherium* Gervais and *Pachynolophus* Pomel; that *Epihippus* and *Eohippus* Marsh are similar to *Lophiotherium* Gervais. It is probably premature to attempt to establish generic identity between these American and European forms; but it is evident that the time is not far distant when such identity is likely to be established, unless we take the ground that the European and American forms were entirely independent in their evolution from the time of their first appearance.

THE PALEONTOLOGICAL LITERATURE OF 1898 AND 1899.

Dr. Max Schlosser, of Munich, again places us in his debt by the continuation of his valuable résumé of the literature upon fossil and recent mammals.* This annual review began in 1884. The present section fills nearly one hundred pages of fine type, and the works reviewed are divided under three heads: (1) Those properly pertaining to Pleistocene anthropology and mammalian remains found with man; (2) the Tertiary and Mesozoic mammals; (3) the distribution and taxonomy of recent mammals. In the exhaustive library of the University of Munich, Dr. Schlosser finds practically the literature of the world, and in this review he gives a brief abstract of all that was published during the years 1898 and 1899. It is the author's custom to fairly present in abstract the works reviewed, including very brief critical remarks of his own. These digests are clear, and remarkably free from prejudice. They are simply priceless for every worker in mammalian paleontology and anthropology, and our thanks to Dr. Schlosser cannot be too heartily expressed.

H. F. O.

* 'Literaturbericht für Zoologie in Beziehung zur Anthropologie,' p. 115, für das Jahr 1898, p. 165 für das Jahr 1899.

SOME SINGULAR NICKEL-STEEL ALLOYS.

Through the courtesy of M. Ch.-Ed. Guillaume, Directeur-adjoint du Bureau international des poids et mesures, Paris, there has come to hand a very interesting collection of documents * relating to a curious variety of nickel-steel alloys, regarding which little seems to have been published on this side the Atlantic, and the only notice of which, according to the inventor, has been in the form of a denial of the possibility of their existence.

M. Guillaume has discovered, has produced in quantity and has brought into use in the industries, an alloy of steel or iron and nickel which he denominates 'non-dilatable'; it remains of substantially constant dimensions with ordinarily varying temperatures. This peculiarity, as he says, is allied to a general anomaly attributable to alloys of this class capable of forming solid solutions which are in certain cases unstable. Forthcoming publications in the French technical and scientific journals are expected to give later information regarding this curious series of alloys which are expected to have important applications in the arts. They are already in use in horological work and the pendulum of constant length may now be had. Instruments of precision, and particularly measuring apparatus for geodetic and other fine work, may be thus constructed.

These alloys are actually produced commercially, at Imphy, by the Société de Commentry-Fourchambault. They are now coming into use for many purposes in Europe, and should be better known in this country. The surveyor's tape, the measuring rod for

* 'Recherches sur les aciers au nickel,' Société d'Encouragement; Paris, 1898; 'Sur les variations temporaires et résiduelles des aciers au nickel réversibles,' *Comptes rendus*, i., CXXIV., 1897; 'Das Leben der Matérie,' *Physikalische Zeitschrift*, 2, 1899; 'Les déformations passagères des solides,' Cong. Int. de physique, 1900; 'Les aciers au nickel,' *ibidem*, 1900; 'Le pendule en acier au nickel,' *Journal Suisse d'horlogerie*, 1902; 'Magnetostriction des aciers-nickel,' *Journal de physique*, 1902; 'La convention du mètre et le Bureau international des poids et mesures,' *Bull. de la Soc. d'Encouragement*, 1902.

geodetic work* and the pendulum are among the first applications to find recognition, but the expectation of M. Guillaume is that it will prove possible to adapt other nickel-steel alloys for substitution for the filament of the common 'incandescent' lamp, a work in fact already in progress.

M. L. Dumas, in his 'Les aciers au nickel à haute teneur'† describes the mechanical properties of above one hundred and fifty of the alloys of these metals. At least one Paris firm, Radiguet et Massiot, on the rue Château-d'eau, has undertaken the marketing of these alloys.

These new discoveries and their outcome may not have as impressive aspects as those which have given us nickel-steel armor-plate or gun-barrels; they perhaps have more real importance to the world. The supply of nickel ores seems likely to prove ample for the immediate future, at least, and scientific men and engineers will be hopeful of still other and useful products in this field. Meantime, M. Guillaume deserves great credit and large returns for his part in the work of exploitation. R. H. THURSTON.

* The recent measurement of the meridional arc on Spitzbergen was effected with this alloy in the measuring wires.

† Published by Dunod, Paris, 1900.

RADIUM.

SIR WILLIAM CROOKS has written to the London *Times* the following letter:

In the presence of a mystery like that of radium any reasonable attempt at explanation will be welcome, so I will ask your permission to revive a hypothesis I ventured to submit to the British Association in my presidential address in 1898. Speaking of the radio-active bodies then just discovered by M. and Mme. Curie, I drew attention to the large amount of energy locked up in the molecular motions of quiescent air at ordinary pressure and temperature, which, according to some calculations by Dr. Johnstone Stoney, amounts to about 140,000 foot pounds in each cubic yard of air; and I conjectured that radio-active bodies of high atomic weight might draw upon this store of energy in somewhat the same manner as Maxwell imagined when he invented his celebrated 'demons' to explain a similar problem. I said it was not difficult so to modify this hypothesis as to reduce it to the level of an inflexible law, and thus bring it within the ken of a philosopher in search of a new tool. I suggested that the atomic structure of radio-active bodies was such as to enable them to throw off the slow-moving molecules of the air with little exchange of energy, while the quick-moving missiles would be arrested, with their energy reduced and that of the target correspondingly increased. (A similar sifting of the swift-moving molecules is common enough, and is effected by liquids whenever they evaporate into free air.) The energy thus gained by the radio-active body would raise its temperature, while the surrounding air would get cooler. I suggested that the energy thus gained by the radio-active body was employed partly in dissociating some of the gaseous molecules (or in inducing some other condition which would have the effect of rendering the neighboring air a conductor of electricity) and partly in originating undulations through the ether, which, as they take their rise in phenomena so disconnected as the impacts of molecules, must furnish a large contingent of Stokesian pulses of short wave-length. The shortness in the case of these waves appears to approach, without attaining, the extreme shortness of ordinary Röntgen rays.

Although the fact of emission of heat by radium is in itself sufficiently remarkable, this heat is probably only a small portion of the energy radium is constantly sending into space. It is at the same time hurling off material particles which reveal their impact on a screen by luminous scintillations. Stop these by a glass or mica screen and torrents of Röntgen rays still pour out from a few milligrams of radium salt, in quantity to exhibit to a company all the phenomena of Röntgen rays, and with energy enough to produce a nasty blister on the flesh, if kept near it for an hour.

In conclusion, if it is not too much trespassing on your space, I should like to express the great admiration which I have, in com-

mon with all English men of science, for the brilliant discovery of radium, and its unique properties—the crowning point of the long and painstaking series of researches on radioactive bodies undertaken by Professor Curie and his talented coadjutor, Mme. Curie.

THE MARINE BIOLOGICAL LABORATORY OF THE U. S. FISH COMMISSION.

The Marine Biological Laboratory of the U. S. Fish Commission at Beaufort, North Carolina, will be opened to investigators on June 1, 1903, for a period of four months.

The laboratory is well equipped with glassware, reagents and running water, both salt and fresh, and is lighted with electricity. The apparatus needed for the collection of materials for investigation is furnished, and an experienced collector will assist in this work. A sailboat and steam launch are available for dredging, trawling and other collecting in the harbor and there is a prospect that facilities will be provided for deep-sea dredging and collecting in the Gulf Stream for a considerable time during this season.

Rooms and board for a limited number of men are furnished at about the cost of supplying the table and caring for the rooms. A well-trained and experienced cook will be in charge of the 'mess.' All water used on the table and for cooking comes from an artesian well driven on the island to a depth of 236 feet. Last season all expenses of living at the laboratory were covered by $5.25 per week and it is probable that this season they will be a little less.

It is well known that the marine fauna of Beaufort is very rich and that pelagic organisms are especially abundant. The climate is neither unpleasant nor unhealthful. The temperature rarely rises above 85° F., and there are few days when a sea breeze does not prevail. The atmosphere is humid, but fogs are almost unknown. With the water and diet provided at the laboratory mess there is no danger to health.

Beaufort is connected with Morehead City, the nearest railroad station, situated across the harbor, by a line of launches which stop at the laboratory wharf. The Atlantic and North Carolina Railroad connects at Goldsboro with the Southern and Atlantic Coast Line railroads. The laboratory may also be reached by an almost all water route via Norfolk, Elizabeth City and New Bern.

Those desiring to occupy tables in the laboratory should write for application blanks to Caswell Grave, Johns Hopkins University, Baltimore, until May 28. After that date to Beaufort, North Carolina.

MONOGRAPH OF NORTH AMERICAN MOSQUITOES.

Dr. L. O. Howard, of the U. S. Department of Agriculture, is engaged in arranging plans for an elaborate monograph of the mosquitoes of North and Central America and the West Indies under a grant from the Carnegie Institution. It is proposed to devote at least three years to the work, and to make the monograph as perfect as possible, both on the systematic and biological sides. The large collections of the U. S. National Museum and the Department of Agriculture will be used as a basis. Trained observers will be stationed at different points, the faunal regions being taken into consideration in choosing localities. Up to the present time the following localities and observers have been selected: Chicopee, Mass., Mr. Frederick Knab; Ithaca, N. Y., Mr. O. A. Johannsen; Minneapolis, Minn., Professor F. L. Washburn; Kaslo, B. C., Dr. H. G. Dyar; Stanford University, Cal., Professor V. L. Kellogg, or an assistant; Salt Lake City, Utah, Mr. R. V. Chamberlin; Victoria, Texas, Dr. W. E. Hinds; Baton Rouge, La., Professor H. A. Morgan; Clemson College, S. C., Professor C. E. Chambliss; Havana, Cuba, Mr. J. R. Taylor; Guanajuato, Mexico, Dr. Alfredo Dugès. Additional localities and observers will be selected later. Dr. Howard will be assisted in the systematic work on the adults by Mr. D. W. Coquillett, of the National Museum, and on the larvæ, by Dr. H. G. Dyar, also of the National Museum, since both of these observers are skilled in these subjects.

Volunteer observers are greatly needed, and it is Dr. Howard's hope that persons interested in this subject, and especially those resident

in the Gulf states and in Central America, will correspond with him and send him material. Investigators already engaged in mosquito work, like Dr. John B. Smith, of Rutgers College, and Professor Glenn W. Herrick, of the Mississippi Agricultural College, will cooperate, it is hoped.

SCIENTIFIC NOTES AND NEWS.

THE University of London will, on June 24, confer the honorary degree of Doctor of Science on Lord Kelvin and on Lord Lister.

PROFESSOR THEODORE BOVERI, of the University of Würzburg, and Professor W. M. Wheeler, who has recently accepted a call from the University of Texas to the American Museum of Natural History, have been elected correspondents of the Philadelphia Academy of Natural Science.

THE Donohoe comet-medals of the Astronomical Society of the Pacific have been awarded to M. Michel Giacobini, astronomer, Nice, France, for his discoveries of unexpected comets on December 2, 1902, and January 15, 1903.

DR. OSKAR UHLWORM, director of the German bureau of the International Catalogue of Scientific Literature, has been given the title of professor.

REAR-ADMIRAL J. G. WALKER, General P. C. Hains, Major William M. Black and Professor William H. Burr, the members of the American commission which is to make an inspection of the Panama Canal route, have arrived at the Isthmus.

AMONG the American physicians who have gone to Madrid to attend the International Medical Congress are Dr. Abraham Jacobi, of New York City; Dr. Nicholas Senn, of Chicago; Dr. Howard Kelly, of Baltimore; and Surgeon-General R. S. Reilly, U.S.A.

PROFESSOR L. G. CARPENTER, of the department of Civil and Irrigation Engineering of Colorado Agricultural College, has been granted a temporary leave of absence in order to act as state engineer of Colorado, which includes lines of work much the same as have been carried on in connection with the work of the experiment station. In the meantime Professor Carpenter will retain his connection with the experiment station and have supervisory control of the Department of Civil and Irrigation Engineering at the college.

MR. J. W. BAIRD, Ph.D. (Cornell), has been appointed by the trustees of the Carnegie Institution to a research assistantship in psychology with Professor Titchener for the academic year 1903–4.

A PORTRAIT of Dr. Richard Caton, the first professor of physiology in University College, Liverpool, has been presented to the college.

PLANS are being made to erect a monument to the philosopher Kant in Berlin, to be unveiled on the occasion of the hundredth anniversary of his death, in 1904.

DR. ALBERT HUNTINGTON CHESTER, professor of chemistry and mineralogy at Rutgers College, died on April 13, at the age of sixty years. He graduated from the Columbia School of Mines in 1868 and later took the degree of Doctor of Philosophy from the same institution. Before going to Rutgers College in 1891, he was for twenty-one years professor at Hamilton College.

DR. G. A. RUNGE, assistant director of the Meteorological Institute at Copenhagen, died on March 28.

WE learn from Professor George E. Hale that Miss Helen E. Snow, of Chicago, has provided for the reconstruction of the coelostat reflecting telescope of the Yerkes Observatory as a memorial to her father, the late George W. Snow. The telescope will be provided with solar and stellar spectrographs, spectroheliographs and other important accessories. It will be remembered that the coelostat reflector which the new telescope is to replace was seriously injured by fire last December, giving rise to erroneous but widespread statements that the main building of the Yerkes Observatory, as well as the 40-inch refractor, had been destroyed.

THE directors of the Benjamin Apthorp Gould fund have appropriated the sum of $400 in aid of the determinations of stellar parallax, in progress at the Washburn Observatory.

The board of aldermen of New York City have voted $75,000 for the New York Zoological Society for the erection of a new ostrich house and for quarters for the mammals.

At the session of the legislature of the state of New Jersey, which has just ended, provision was made to carry out the law passed the year previously, which authorized an investigation into the habits of the mosquitoes infesting the state, and experiments looking towards their destruction. An appropriation of nine thousand dollars was made, of which five thousand is available during the current season and four thousand during the season of 1904. The investigation is placed in charge of the State Experiment Station, and Professor John B. Smith has been appointed to make it. Active field work is already in progress and much has been learned concerning the early habits of some of the species infesting marsh lands. It is intended to devote most of the time during the present year to the coastal areas and to the outskirts of the larger cities.

Mr. Andrew Carnegie has offered Cleveland $250,000 for the establishment of seven branch libraries, providing the city gives the sites and an annual appropriation of $25,000 a year. The library board has accepted the offer.

Two research studentships, of the value of £150 a year each—one in physics and one in biology—will be awarded this year by the Royal Society. Applications are to be made by June 1 to the assistant secretary of the Royal Society, Burlington House, London, W.

The Danish parliament has appropriated $1,000,000 for new buildings for the Medical School and Hospital of the University of Copenhagen.

Reuter's Agency is informed that Dr. T. Rubin, of Upsala, the leader of the scientific expedition which has been despatched to Africa by the British South Africa Company, has left England. He was accompanied by Dr. Stoehr, the medical officer. After conferring with Sir David Gill, the astronomer-royal at Cape Town, Dr. Rubin and the other members of the expedition, who will join him in South Africa, will leave for Chinde *en route* for Fort Jameson. He will then confer with the administrator of Northeast Rhodesia, and at once proceed to the work of the geodetic survey.

Four members of the German Antarctic expedition, which left Germany in August, 1901, have arrived at Sydney, N. S. W., from Kerguelen Island, where during eighteen months this detached party, under the leadership of Dr. Werth, pursued its investigations.

The marine laboratory of the Zoological Department of the University of California which has been located at San Pedro, California, during the past two years, will be moved to San Diego for the next year. The investigations carried on during the coming year by the laboratory will be chiefly on the plankton of San Diego Bay and the adjacent waters. Funds for carrying on the work of the station are furnished by the chamber of commerce of San Diego.

A new botanical and horticultural laboratory which has been established by the Royal Botanic Society in connection with its school in Regent's Park was opened on April 1. The building, which has been fitted up, will accommodate about thirty students.

We learn from the London *Times* that the program of the annual meeting of the Iron and Steel Institute of Great Britain (to be held at Westminster on May 7 and 8) promises to be more than usually interesting. Mr. Andrew Carnegie's inaugural address will deal with the great organizations of capital and labor in the world, and particularly with reference to American industrial problems. Mr. Carnegie will also present Sir James Kitson, M.P., with the Bessemer gold medal for his services to the iron and steel industries of Great Britain. The work of the research scholars endowed by Mr. Carnegie will also be submitted. The following papers will be read: Mr. Talbot, of Leeds, will give the results obtained by making steel from a 200-ton furnace by a continuous process; Mr. Keller, of Paris, will describe the successful manufacture of steel in the electric furnace; and C. von Schwarz, of Liége, will show how blast furnace slag

can be made into Portland cement; Mr. C. Mercader, of the Carnegie Works at Pittsburgh, will for the first time in public describe the plant for manufacturing hollow pressed axles for railroads.

The subject for the Adams prize of Cambridge University, open to all persons who have at any time been admitted to a degree, is: "Wave motion of finite amplitude and unchanging type, in deep water. Hitherto only one type of such motion has been discovered, that of Gerstner and Rankine, which involves vorticity; it is suggested that on examination this might be found to be a special case of a more general solution. No exact solution has hitherto been obtained in which the motion is irrotational; it is desirable that the question should be examined whether the known approximate solution is in fact an approximation to a permanent state of motion. In default of a conclusive answer to the above questions, any considerable advance in the theory of the subject, apart from an extension of the known approximations, is desirable." The successful candidate will receive about £225. The essays must be sent to the vice-chancellor on or before December 16, 1904.

In accordance with the provisions of the charter, the by-laws of the British Academy have been allowed by the Privy Council. The by-laws regulate the number of fellows, the council, sectional committees, general meetings, election of fellows and preliminary arrangements. The number of ordinary fellows is fixed at one hundred as a maximum limit, but it shall not be necessary to complete that number. The International Association of Academies has unanimously agreed to the admission of the association as a constituent academy in the philosophico-historic section. Lord Reay (president of the academy) has been nominated by the academy as a member of the International Council. Mr. Bryce, Sir R. C. Jebb and Professor Pelham have been appointed to represent the academy at the forthcoming International Congress of Historical Studies, to be held in Rome. The fellows of the academy are distributed under four main sectonal committees, each section having its own chairman: (1) History and Archeology, chairman, Mr. Bryce; (2) Philology, chairman, Sir R. C. Jebb; (3) Philosophy, chairman, Dr. Edward Caird; (4) Jurisprudence and Economics, chairman, Sir C. P. Ilbert.

The International Agricultural Congress was inaugurated at Rome on April 13 in the presence of King Victor Emmanuel and Queen Helena. About 1,300 delegates were present. The American representatives are Dr. Daniel E. Salmon, chief of the United States Bureau of Animal Industry, and Henry E. Alvord, chief of the Dairy Division of that bureau.

A Universal Exposition of Sciences, Arts and Industries will be held at Liége, Belgium, in the year 1905.

The American Electrochemical Society held its third general meeting in New York, on April 16 to 18.

The Spokane Science Club, of Spokane, Wash., held a meeting on March 10, at which papers were read by Mr. J. Y. McMullen, on DeVries' mutation theory and Mendel's law and by Mr. E. Channing Moore on the hydrocarbons. The correspondent who sends us this information calls attention to the value of such local clubs for scientific study and urges their establishment wherever possible.

On May 6 there will be civil service examinations for the positions of assayer in the Mint Bureau, Treasury Department, at a salary of $2,200; for the position of editorial clerk in the Geological Survey at a salary of $1,500, and for the position of clerk in nutrition investigations, Office of Experiment Stations, Department of Agriculture, at a salary of from $720 to $1,000. On May 26 and 27 there will be an examination for the position of forest draftsman in the Bureau of Forestry, Department of Agriculture, at a salary of $900.

Messrs. Charles Scribner's Sons announce that they have arranged for the publication of a 'Library of Historical Psychology,' under the editorial supervision of Professor James Mark Baldwin, LL.D., of Princeton Univer-

sity. The library is to comprise a series of volumes on the history of the various topics of psychological thought from the earliest times, each volume being an independent work, but the whole constituting an encyclopedic 'History of Psychology'—a work never adequately carried out in any language. The arrangements for the volumes of the library—of which there will be twelve or more—are now being perfected, and the publishers expect to make early announcement of certain of the titles, names of writers, etc.

The following are the spring lecture arrangements at the Royal Institution: Professor Allan Macfadyen, three lectures on the blood and some of its problems; Professor G. H. Darwin, two lectures on the astronomical influence of the tides (the Tyndall lectures); Professor E. J. Garwood, two lectures on the work of ice as a geological agent; Professor Dewar, three lectures on hydrogen: gaseous, liquid and solid; Professor S. H. Vines, two lectures on proteid-digestion in plants; Professor J. A. Fleming, two lectures on electric resonance and wireless telegraphy; Professor Langton Douglas, two lectures on the early art of Siena; Mr. Hamish MacCunn, two lectures on music (with musical illustrations); and Professor Silvanus P. Thompson, two lectures on the De Magnete and its author, (1) the book, (2) the man. The Friday evening meetings will be resumed on April 24, when a discourse will be given by the Hon. R. J. Strutt on some recent investigations on electrical conduction. Succeeding discourses will probably be given by Professor William J. Pope, Mr. Rider Haggard, Dr. D. H. Scott, Dr. J. A. H. Murray, the Prince of Monaco and others.

UNIVERSITY AND EDUCATIONAL NEWS.

It is now officially announced that Mrs. Elizabeth Milbank Anderson gave on April 17, $1,000,000 to Barnard College, Columbia University, to purchase the three blocks of land adjoining Columbia College on the south and Barnard College on the west. Mr. Joseph Pullitzer has given $15,000 for scholarships to the university.

Mr. Andrew Carnegie has given $250,000 for an extension of the Mechanics and Tradesmen's Institute, New York City.

Dr. D. K. Pearsons, of Chicago, celebrated his eighty-third birthday on April 14, by making anniversary gifts to two colleges, Winter Park, Florida, $50,000 and Kingfisher College, Oklahoma, $25,000.

The Colorado Agricultural College will soon erect a building for the Department of Civil and Irrigation Engineering. This building will include also the offices of the Experiment Station during 1903–4. An appropriation of $40,000 has been made by the Colorado State Legislature.

Mr. John D. Rockefeller has offered to pay two thirds of the cost of a building for the University of Nebraska to be used for social and religious purposes, on condition that the remaining third of the $100,000 be contributed within about a year.

Mrs. Helen F. Ackley has left to Wesleyan University a bequest of $2,000, the income from which is to be used for the benefit of one or more women students; if at any time the trustees of the college refuse to accord women the same privileges in the university as the men, the fund is to revert to the residuary legatee.

The will of A. C. Hutchinson, leaving a large sum to the Medical Department of Tulane University, has been sustained by the courts.

Professor Elmer E. Brown, head of the Department of Education at the University of California, has been elected dean of the School of Pedagogy at New York University.

Mr. Joel Stebbins, fellow in the Lick Observatory, University of California, has been appointed instructor in astronomy, University of Illinois, and officer in charge of the observatory.

Mr. G. F. Stout, Wilde reader in mental philosophy at Oxford University and editor of *Mind,* has been elected to the chair of philosophy and metaphysics at the University of St. Andrews, vacant by the death of Professor Ritchie.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 1, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY.

THE general meeting of the American Philosophical Society was held in Philadelphia on Thursday, Friday and Saturday, April 2, 3 and 4. A large number of members were in attendance, and the meeting was in every way a most successful and important one. Morning and afternoon sessions were held in the historic hall of the society on Independence Square, and luncheons were served here each day to members and invited guests. On Thursday evening a reception for members of the society and their friends was held at the hall of the Historical Society of Pennsylvania, on which occasion the president, Professor Edgar F. Smith, delivered an address on the origin and early history of the American Philosophical Society, which will be published in full elsewhere. On this occasion President Daniel C. Gilman of the Carnegie Institution also spoke on the work of that institution during the first year of its development. Professor Wm. H. Welch, who was to have spoken on the objects and aims of the Rockefeller Institute for Medical Research, was prevented by sickness from being present.

At the close of the morning session on Friday the annual election of members was held, and the following persons were chosen:

Residents of the United States.—Edward E. Barnard, Sc.D., Williams Bay, Wis.; Carl Hazard Barus, Ph.D., Providence, R. I.; Franz Boas, Ph.D., New York; William W. Campbell, Sc.D., Mt. Hamilton, Cal.; Eric Doolittle, Philadelphia; Basil Lanneau Gildersleeve, LL.D., Baltimore; Francis Barton Gummere, Ph.D., Haverford, Pa.; Arnold Hague, Washington, D. C.; George William Hill, LL.D., Nyack, N. Y.; William Henry Howell, Ph.D., Baltimore; Edward W. Morley, Ph.D., Cleveland; Harmon N. Morse, Ph.D., Baltimore; Edward Rhoads, Haverford, Pa.; Alfred Stengel, M.D., Philadelphia; William Trelease, Sc.D., St. Louis.

Foreign Residents.—Anton Dohrn, Naples; Edwin Ray Lankester, LL.D., F.R.S., London; Sir Henry E. Roscoe, F.R.S., D.C.L., London; Joseph John Thomson, D.Sc., F.R.S., Cambridge, Eng.; Hugo de Vries, Amsterdam.

Action was also taken at this session looking to the adequate celebration of the two hundredth anniversary of the birth of Franklin, the founder of the organization. This was expressed in the following preamble and resolution which were unanimously adopted:

Inasmuch as the two hundredth anniversary of the birth of Benjamin Franklin occurs in January, 1906, it is proper that the American Philosophical Society, which owes its existence to his initiative and to which he gave many long years of faithful service, should take steps to commemorate the occasion in a manner befitting his eminent services to this society, to science and to the nation. Therefore be it

Resolved, That the president is authorized and directed to appoint a committee of such number as he shall deem proper to prepare a plan for the appropriate celebration of the bi-centennial of the birth of Franklin, and to report the same to this society.

The president appointed the following members to constitute the committee: Hon. George F. Edmunds, *Chairman;* Professor Alexander Agassiz, Boston; President James B. Angell, Ann Arbor; Professor George F. Barker, Philadelphia; Professor A. Graham Bell, Washington; Mr. Andrew Carnegie, New York; Professor C. F. Chandler, New York; Hon. Grover Cleveland, Princeton; President Charles W. Eliot, Cambridge; President Daniel C. Gilman, Baltimore; President Arthur T. Hadley, New Haven; Provost C. C. Harrison, Philadelphia; Hon. John Hay, Washington; Dr. I. Minis Hays, Philadelphia; Professor Samuel P. Langley, Washington; Capt. Alfred T. Mahan, U. S. N.; Dr. S. Weir Mitchell, Philadelphia; Professor Simon Newcomb, Washington; Governor S. W. Pennypacker, Harrisburg; Professor E. C. Pickering, Cambridge; Professor Michael I. Pupin, New York; President Ira Remsen, Baltimore; Professor John Trowbridge, Cambridge; Dr. Charles D. Walcott, Washington; Hon. Andrew D. White, Ithaca; President Woodrow Wilson, Princeton.

On Friday evening the annual dinner of the society was held at the Hotel Bellevue, at which about eighty members were present, the occasion being a most enjoyable one and a fitting climax to the social side of the meeting. Professor W. B. Scott acted as toastmaster and the following toasts were responded to:

'The Memory of Franklin,' Professor Albert H. Smyth, of Philadelphia.

'Our Sister Societies,' Rear Admiral Melville, of Washington, and Professor Henry F. Osborn, of New York.

'Institutions for the Promotion of Knowledge,' Dr. Cyrus Adler, of Washington.

'The American Philosophical Society,' Mr. J. G. Rosengarten, of Philadelphia.

The opinion was freely expressed, by many members who had come from a distance, that the entire meeting was one of the most enjoyable and profitable which

they had ever attended. All were hearty and unanimous in the desire that the general meetings of the society should be continued and made an annual event. No further justification of these meetings is needed than that they have been successful, that they have attracted many members from a distance and that their continuance is desired by those who are acquainted with them; furthermore, it should not be necessary to defend our oldest scientific society for carrying out in practical form the broad policy which it has upheld for more than a century and a half.

Nevertheless, since there has been some misunderstanding as to the purpose of these general meetings, it may not be amiss to point out the fact that in no sense are they intended to antagonize or to supplant the meetings of other societies. On the contrary, they occur at a time when few other societies are meeting and they attract papers of a general rather than of a specialized character. The broad and comprehensive scope of the society, which includes the whole range of useful knowledge, so far from being a hindrance to the success of the meetings, has been a particular attraction and source of strength. The opportunity of hearing and becoming acquainted with men eminent in the most diverse fields of thought is likely to promote catholicity of spirit even if it does not greatly advance individual specialties, and, after all, the present world stands quite as much in need of the former as it does of the latter. Amidst all the special societies which exist in this country there is surely room for one which shall welcome learned men from all fields whatsoever, and it is fitting that this common meeting ground should be the oldest learned society in America, founded by the many-sided Franklin, and devoted to the promotion of useful knowledge, 'nullo discrimine.'

The program of the meeting with abstracts of some of the papers presented follows; most of these papers will be printed in full in publications of the society:

THURSDAY, APRIL 2.

Morning Session, 10 o'clock.

President Smith in the chair.

President's Address of Welcome: Professor EDGAR F. SMITH.

The Structure of the Corn Grain and Its Relation to Popping: Professor HENRY KRAEMER, of Philadelphia.

There is a marked difference in the structure of the several parts of corn grains, and according to the character of the endosperm three distinct kinds of grains may be distinguished as follows: (1) One variety, representing the sweet corns, contains comparatively few nearly spherical starch grains from 4 to 10 microns in diameter, besides considerable dextrin becoming red with iodine, and a small amount of a reducing sugar. (2) The second class includes the dents and possibly also the soft corns, and in these the greater portion of the endosperm is whitish and more or less mealy; the starch grains in this mealy area are rounded or slightly polygonal, vary from 5 to 25 microns in diameter, and have a central rarefied area or point of origin of growth, which may be either wanting or usually not more than 2 microns in diameter. (3) The third class includes the pop-corns, in which the endosperm is more or less translucent and horny, and the cells of which contain closely arranged polygonal starch grains from 7 to 18 microns in diameter, and having a central rarefied area from 2 to 7 microns in diameter. Some of the flint corns closely resemble the pop-corns and form a group intermediate between the latter and the dent corns.

If the entire grains of these several groups are heated in a popper or in a hot-air oven at a temperature between 145°C.

and 160°C. for from four to ten minutes, there will be a splitting or popping open of the grain from the apex and a modification of the contents varying according to the kind of corn. In the sweet corn the grain swells very perceptibly, becoming hollow in the center, the endosperm becoming more or less friable and containing an increased amount of reducing sugars. In the dent corns there is a splitting of the hulls and the endosperm, and this may take place on the flat surface or along the edge, or the upper portion may separate like a lid. There is not much alteration in the endosperm cells of this class, only a small amount of soluble starch being formed. In the pop-corns there is a splitting of the grain along the two radii, the endosperm swelling very considerably, the peripheral portions cohering with the hull and thus leaving a central more or less rounded mass; where the popping is perfect the quarters turn back and meet below the embryo. On examining the endosperm of the popped grain it is observed that there has been considerable alteration in the starch grains and cell walls, and that the starch has been changed into a soluble form, the amount of which depends upon the degree of alteration in the endosperm cells and their contents.

The structural characteristics of the starch grains in the altered areas of the different pop-corns would seem to indicate that the popping of the grain of corn results from the expansion of the individual starch grains, the degree of expansion depending upon the relative amount of water and air in the grains. As an illustration of this it may be stated that perfectly fresh pop-corn or pop-corn that has been soaked in water for twenty-four hours will pop but little in the true sense of the word. On the other hand, a pop-corn which was seven years old, but had not lost its germinating power, would not pop unless first soaked in water and then allowed to dry for from four to twelve hours. That this property probably resides in the starch grain is further shown by the fact that pieces of the pop-corn grain will pop.

Beaver County (Pa.) Orchids: Mr. Ira Franklin Mansfield, of Beaver, Pa.

A brief account of twenty-eight species of orchids which the writer has found in Beaver County, Pa.

The Forward Movement in Plant Breeding: Professor L. H. Bailey, of Ithaca, N. Y.

The current idea in plant breeding is to breed 'varieties,' to produce something 'new' that can be named and described. However, a variety is not a thing or an entity, but only an aggregation of forms that agree rather more than they differ. Any one of these minor forms might be separated as another variety. The ultimate form or unit is the individual plant, and from this individual, irrespective of the variety it represents, the plant-breeding of the future must proceed.

The new idea is to breed for definite characters that make for efficiency. We must 'scale' our plants according to what they perform or what they contain. Thus, the new corn breeding does not attempt to produce new 'varieties' of corn, but to increase the efficiency of any variety by increasing its yield, protein or starch content, its drought-resisting or disease-resisting qualities. The new work with corn in Illinois, with wheat in Minnesota, with cotton and other crops by the United States Department of Agriculture, was described and illustrated.

The first thing that strikes one in all this work is its contrast with the old ideals. The 'points' of the plants are those of 'performance' and 'efficiency.' It brings into sharp relief the accustomed ideas as to what are the good 'points' in any plant, illustrating the fact that these points are

for the most part only fanciful, are founded on *a priori* judgments, and are oftener correlated with mere 'looks' than with efficiency. An excellent example may be taken from corn. In 'scaling' any variety of corn, it is customary to assume that the perfect ear is one nearly or quite uniformly cylindrical throughout its length, and having the tip and butt well covered with kernels. In fact, the old idea of a good variety of corn is one that bears such ears. Now, this ideal is clearly one of perfection and completeness of mere form. We have no knowledge that such form has any correlation with productiveness, hardiness, drought-resisting qualities, protein or starch content, and yet these attributes are the ones that make corn worth growing at all. An illustration also may be taken from string beans. The ideal pod is considered to be one of which the tip-projection is very short and only slightly curved. This, apparently, is a question of comeliness, although a short tip may be associated in the popular mind with the absence of 'string' in the pod; but we do not know that this character has any relation to the efficiency of the bean pod. We are now undergoing much the same challenging of ideas respecting the points of animals. These 'points,' by means of which the animals are 'scored,' are in large part merely arbitrary. Now, animals and plants are bred to the ideals expressed in these arbitrary points, by choosing for parents the individuals that 'score' the highest. When it becomes necessary to recast our 'scales of points,' the whole course of evolution of domestic plants and animals is likely to be changed.

We are to breed not so much for merely new and striking characters that will enable us to name, describe and sell a 'novelty,' as to improve the performance along accustomed lines. We are not to start with a variety, but with a plant. It is possible to secure a five per cent. increase in the efficiency of our field crops. This would mean the annual addition of hundreds of millions of dollars to the national gain.

The purpose, then, of our new plant-breeding is to produce plants that are more efficient for specific uses and specific regions. They are to be specially adapted. These efficiency ideals are of six general categories:

1. Yield ideals.
2. Quality ideals.
3. Seasonal ideals.
4. Physical conformation ideals.
5. Regional adaptation ideals as to climate, altitude, soil, etc.
6. Resistant ideals as to diseases and insects.

The main improvement and evolution of agriculture are going to come as the result of greater and better crop yield and greater and better animal production. It is not to come primarily from invention, good roads, rural telephones, legislation, discussion of economics. All these are merely aids. Increased crop and animal production are to come from two agencies—improvement in the care that they receive and improvement in the plants and animals themselves. In other words, the new agriculture is to be built upon the combined results of better cultivation and better breeding. So far as the new breeding is concerned, it is characterized by perfect definiteness of purpose and effort, the stripping away of all arbitrary and factitious standards, the absence of speculative theory and the insistence on the great fact that every plant and animal has individuality.

Development of the English Alphabet: Professor FRANCIS A. MARCH, of Lafayette College, Easton, Pa.

Language is growth. We will to utter sounds, and the muscles move by their own

laws. The sounds weaken by the law of least effort, strengthen under the accent, are assimilated by neighboring sounds while the writing of a word remains unchanged, so that any letter may come to stand for any sound and any sound be found represented by many different letters. This is the condition of a language as it grows. Such a language needs to be shaped by reason to the use of man.

An alphabet addressed to the eye is machinery to suggest the elementary significant sounds, and is open to improvement like all labor-saving machinery.

The Roman alphabet was a simple set of largely straight-line forms suited for cutting in stone from right to left like our capitals. It has been improved into cursive forms easily connecting from left to right. This change was established in the fifteenth century.

It brought two forms of *I* into use, *i* and *j*. The penmen often swept the *i* below the line with a flourish, and the types *i* and *j* were used indifferently for either the vowel or consonant force of the Roman *I*. In the beginning of the seventeenth century they were differentiated and *j* used only as a consonant.

The Roman *V* also had two cursive forms, *v* and *u*, used indifferently for vowels and consonants, differentiated at the same time, all under the lead, as our Dr. C. P. G. Scott has lately shown us, of the great scholar Philemon Holland and his printers.

The philologists have also developed six continuant lingual consonant diagraphs with a diacritic *h*, viz., *dh, th, sh, zh, dzh* = *j*, *tsh* = *ch*, to which the attention of workers in alphabetics is invited. There are also a new type *z* for sonant *s* and a nasal *ng*.

But the vowels are the most tangled field. Between *A* and *E* has been established the sound in 'at,' 'fare'; between *A* and *O* that in 'not,' 'nor'; between *A* and *U* that in 'fun,' 'burn.' Three new types are wanted. It is proposed to obtain them as Holland did. There are two forms (*a* and *ă*) used for both the sounds in 'father' and făt'; *a* is to be used always for the first, *ă* for the last. "I can't tell a lie, papa; you know I can't. I did it with my little hătchet." The words are not obscured, the spelling is perfected.

There are two graphic forms (*o* and *ŏ*) used for the sounds of 'no' and 'not'; *o* must be used only for the first, *ŏ* only for the second sound.

So let the lower case *u* be used only for the vowel in 'full,' 'rule' and the small capital *U* only in 'but,' 'burn,' etc. It will be seen in accompanying diagrams how easily the use of these types may be introduced, and how far the general use of them will go in reducing our chaos to cosmos.

The society is urged to use types in her documents as plainly within her general sphere, 'philosophy for fruit,' as a special field in which her members have always been leaders from Franklin to Haldeman, and the authors of the last state paper on spelling. This is a time of crisis. The language of the Pacific and the coming world ought not to be left to pidgin English.

Archeology and Mineralogy: Professor PAUL HAUPT, LL.D., Johns Hopkins University, Baltimore, Md.

In seven passages of the Old Testament we find references to a precious stone of Tarshish, *i. e.*, southern Spain (Exod. xxviii. 20, xxxix. 13; Ezek. i. 16, x. 9, xxviii. 13; Song of Solomon, v. 14; Dan. x. 6). As a rule, it is stated that the Greek Bible translates 'chrysolite,' and that the chrysolite of the ancients was our topaz; but the passage of Pliny quoted in support of this view clearly points, not to topaz, but to crystals of cinnabar. Anthrax also, which the Greek Bible has for

tarshish in Ezek. x. 9, means cinnabar. Pliny calls cinnabar *minium,* while we apply this term to the yellowish-red oxide of lead which is called by Pliny *usta cerussa.* Pliny says the best chrysolites are those which, when brought in contact with gold, make the gold look like silver; this is, of course, due to the 86 per cent. of mercury in the crystals of cinnabar (Pliny, xxxvii. 126: *optimæ sunt quæ in conlatione aurum albicare quadam argenti facie cogunt*). Pliny states that the Romans received cinnabar almost exclusively from Spain, and the best cinnabar came from *Sisapo,* the present quicksilver mines of Almaden, north of Cordova in southern Spain.

Just as Pliny applies the name *minium* to cinnabar, so the ancients used the name 'sapphire' for lapis lazuli. The ancients received lapis lazuli almost exclusively from the famous mines in Badakhshan, the mountainous region in northeastern Afghanistan, on the northeastern flank of the Hindukush, the Paropannisus of the ancients. The Assyrian king Esarhaddon (680–668 B. C.) calls this lapis lazuli mountain *Bikn,* adding that it was situated in the remotest part of Media. Esarhaddon must have advanced to the Paropannisus, as far east as did, three hundred years later, Alexander the Great, and the Macedonian conqueror would probably not have extended his victorious march so far east if he had not obtained in Babylonia some information regarding those eastern regions.

After we have established the fact that the sapphire of the ancients denotes lapis lazuli, while the stones of Tarshish represent crystals of cinnabar, we can explain the stanza in the Biblical love-ditties (Song of Solomon, v. 14) where the maiden describing the beauty of her lover says:

> His arms are poles that are golden,
> bedecked with rubies of Tarshish;
> His body is one piece of ivory
> adorned with azure blue sapphires.

That is, his bronzed arms are covered with ornamental designs tattooed in vermilion (the brilliant red pigment formerly made by grinding select pieces of cinnabar), while his white body is tattooed in ultramarine (the beautiful blue pigment formerly obtained from lapis lazuli). Tattooing has been common among the Semites from the earliest times. The mark which the Lord appointed to Cain was a tattooed tribal mark.

I maintain, therefore: the stones of Tarshish are ruby-like crystals of cinnabar from the quicksilver mines of Almaden, and Tarshish is a Phœnician word meaning 'dressing of ores,' especially 'spalling.' King Solomon's mines were located in southern Spain and in southeastern Africa; the silver came from Spain and the Ophir gold from the Eldorado north of the former South African Republic, opposite Madagascar.

The Activity of Mont Pelée: Professor ANGELO HEILPRIN, of Philadelphia. Illustrated with lantern slides.

Reaction as an Agent in Securing Navigable Depths in River and Harbor Improvements: Professor LEWIS M. HAUPT, of Philadelphia.

This paper dealt with the necessity which exists for deeper channels to meet the requirements of modern vessels; the inability of contending with the ceaseless activities of nature by mechanical means; the enormous tonnage which requires ample facilities for its rapid and economical distribution by the cheapest medium; the existing resources of the engineer as at present applied and the results secured therefrom; the rapid increase in the annual appropriation for the construction and maintenance

of this class of works, and the latest developments which have proved the practicability of a new form of tool for securing results by the utilization of the principle of reaction, instead of velocity and concentration by means of two jetties. It also emphasized the inability of currents of fresh water to scour to sufficient depths when buoyed up by the heavier salt water which obstructs and raises them on their path over a bar and the greater specific gravity of the wave-driven sand, or littoral drift, of which the bars of tidal inlets are composed. The location and cause of the abnormal depths found in gorges or under the lee of obstacles, and the resultant counter-scarps, illustrated by numerous slides showing the proper position and form to secure a continuous channel across an obstructing bar at half the cost of the usual devices, and by natural forces which will maintain the channels which they carve.

The above general claims and principles were illustrated and confirmed as to their value by a practical demonstration on a large scale of incompleted work on the coast of the Gulf of Mexico, which has proved to be remarkably permanent and effective.

Afternoon Session, 2 o'clock.

Vice-President Barker in the chair.

The Curtis Steam Turbine: Mr. W. L. R. Emmet, of Schenectady, N. Y.

The Principle of Least Work in Mechanics, and its Possible Use in Investigations Regarding the Ether of Space: Professor Mansfield Merriman, of Bethlehem, Pa.

The use of this principle in engineering computations was briefly explained. It was pointed out that its application is only valid in the case of bodies that are perfectly elastic and that its successful use in the determination of stresses in indeterminate structures depends upon this assumption. If the ether of space be perfectly elastic it is probable that the principle of least work can be applied to determine the stresses which accompany the action of gravitation, and an effort is being made in this direction, the results of which appear to indicate that the ether has properties in some respects unlike those of elastic bodies.

The Nernst Lamp (with experimental demonstration): Mr. Alexander Jay Wurts, of Pittsburg.

The Problem of the 'Trusts': Mr. C. Stuart Patterson, of Philadelphia.

An Inquiry into the Relation between the Objective Operations and Events Revealed to Us by the Scientific Study of Nature, and the Corresponding Actual Operations and Events Which are What Have Taken Place in the Universe of Real Existences: Professor G. Johnstone Stoney, F.R.S., of London.

Hitherto every attempt to ascertain the events that are actually happening in the universe of real existences—in other words, the study of ontology—has been pursued almost exclusively from the human standpoint of the metaphysician. This limited mode of treatment has led to a few negative results, which are chiefly of value by helping to dispel popular errors; but it has established little that is positive, or that can be of service to the scientific student of nature. And yet the scientific investigation of nature has led us in more than one direction into contact with problems of ontology—as when physiology brings us face to face with such a fact as that there is some interpendence between the thoughts that are our mind, and objective events going on in our brain. What help has ontology rendered in a case of this kind, or throughout our studies in physics, when we make any attempt to penetrate to the causes of the events that occur? In fact,

the inquiries hitherto made into ontology have been pursued on a wholly different plane, and do not seem to have solved any of the real enigmas which the study of nature presents. It appears, therefore, in an eminent degree desirable that an attempt shall be made to bring ontological studies into line with physical by ascertaining in what way the scientific study of nature (with which experience shows that the human mind is fitted to cope) stands related to the real events and real existences of which the universe actually consists (but which our human minds find it more difficult to probe).

The aim of the present paper is, therefore, to bring ontological and physical investigations into accord by substituting a Copernican for the Ptolemaic point of view of the metaphysician, and by throughout following up the ontological investigation from the standpoint of the student of nature.

FRIDAY, APRIL 3.

Morning Session, 10 o'clock.

Vice-President Langley in the chair.

The Double Star System Σ 518: Mr. ERIC DOOLITTLE, of Philadelphia. (Introduced by Professor M. B. Snyder.)

The Constant of Aberration: Professor CHARLES L. DOOLITTLE, of Philadelphia.

The Degree of Accuracy of the Newtonian Law of Gravitation: Professor ERNEST W. BROWN, F.R.S., of Haverford, Pa.

Two bodies attract one another inversely as the square of the distance, that is, if the distance be halved the force is increased four times; if the distance is divided by ten the force is increased one hundred times. This is the Newtonian law of gravitation. The moon, earth, sun and planets all should obey this law, which was discovered by Isaac Newton in the seventeenth century.

How far do the bodies obey it? The most sensitive is the moon. We are able to observe its motions so accurately and predict its places with such unfailing certainty by means of this law that we can scarcely have much doubt that it is correct. But, nevertheless, there are some small deviations, and the question is whether these deviations are due to errors in the calculations of astronomers or to something wrong in the law itself.

Hansen's theory of the moon's motion has been accepted up to the present, but there are still some small differences between his theory and observation. Two at least of these have been unexplained in the periods of revolution of the perigee and node. My calculations have shown that the differences are due to errors in Hansen's theory and that on a correct theory they do not exist. Thus it appears that Newton's law is accurate to one millionth per cent.! It is by far the most accurate physical law known and perhaps the most striking evidence of the fact that our existence and surroundings are not the result of chance.

New Applications of Maclaurin's Series in the Solution of Equations and in the Expansion of Functions: Professor P. A. LAMBERT, of Bethlehem. (Introduced by Professor C. L. Doolittle.)

In an equation of any degree, numerical or literal, $f(y)=0$, introduce a factor x into several terms. There results an equation $f(x, y)=0$ which defines y as an implicit function of x. The successive derivatives of y with respect to x are now formed, and the values of y and the derivatives found when $x=0$. An application of Maclaurin's series gives the value of y in a series in powers of x multiplied by factors which depend on the coefficients of $f(x, y)=0$. By properly selecting the terms of $f(y)=0$ into which the factor x is introduced and placing $x=1$ in the

series values of y, all the roots of the equation $f(y)=0$, real and imaginary, are found in convergent series involving only the coefficients of $f(y)=0$.

The same device of introducing a factor x which is eventually made unity makes it possible to obtain by a direct application of Maclaurin's series all the expansions which hitherto have been obtained by Lagrange's series and Laplace's series.

The Mechanical Construction and Use of Logarithms: Mr. Charles E. Brooks, of Baltimore. (Introduced by Professor George F. Barker.)

In this paper is described a simple instrument for constructing the logarithmic spiral with great accuracy. The device will be useful for drawing the curve in the class room; it may be used also for the preparation of tables of logarithms of all the possible systems, or for the mechanical solution of arithmetical problems.

The machine consists of a screw pivoted so that it may be rotated, but will remain parallel to the paper. A wheel is threaded to the screw and rests with its circumference on the paper. As the screw is rotated, the wheel rolls on the paper, but this rolling makes it travel along the screw. The track of the rolling wheel is, therefore, a spiral.

To show that this spiral is the logarithmic curve, consider the equation of motion of the center of the wheel, which has the same motion as the point which draws the curve. Let OA (see figure) be the screw, pivoted at O; let B be the wheel; C its center. Call C the point $\rho\theta$ measuring with O as origin and any line OP as axis. Let the pitch of the screw be p, and the radius of the wheel be r.

As θ increases an amount $\Delta\theta$, c moves through an arc cc' equal $\rho\Delta\theta$. At the same time the wheel turns through an arc $\rho\Delta\theta$, so the angular motion around OA is

$$\frac{\rho\Delta\theta}{r}.$$

Under the influence of the thread on OA it is moved along OA a distance

$$p\cdot\frac{\rho\Delta\theta}{r}.$$

But this distance is $\Delta\rho$, so we have

$$\Delta\rho=\frac{p\rho\Delta\theta}{r},$$

or

$$\frac{\Delta\rho}{\Delta\theta}=\frac{p}{r}\rho,$$

and in the limit,

$$\frac{d\rho}{d\theta}=\frac{p}{r}\cdot\rho.$$

Integrating,

$$\rho=ce^{\frac{p}{r}\theta}$$

That is, θ is the logarithm of ρ.

The Theory of Assemblages and the Integration of Discontinuous Functions: Professor I. J. Schwatt, of Philadelphia. (Introduced by Professor C. L. Doolittle.)

An historic review of the state of the theory of continuous and discontinuous functions prior to the creation of the theory of assemblages by Bolzano and Cantor is first given. It is then shown how the theory of assemblages has served to make this part of the theory of functions more clear and definite. The question of the content of a mass of points, distributed along a line, is discussed; the more important principles of the theory of assemblages are given, and applications of these principles to the integration of discontinuous functions are made.

The Franklin Papers in the Library of the American Philosophical Society: Mr. J. G. Rosengarten, of Philadelphia.

In the collection of this society there are some seventy large folio volumes of 'Franklin Papers.' Franklin left all his papers to his grandson, William Temple Franklin,

who, after a long interval, published in London and in Philadelphia six volumes of Franklin's works. Of course, this represented but a small part of his papers. Those used in the preparation of Temple Franklin's edition are now the property of the United States, which has never yet printed a calendar of them. Temple Franklin selected from his grandfather's papers those that he thought suitable for publication, and left the rest of them in charge of his friend, Charles Fox, to whom he bequeathed them, and Charles Fox, in turn, after a long lapse of years, presented them to the American Philosophical Society, in whose custody they have remained ever since.

They have been roughly classified, and are bound in a rude and careless way. Under the present efficient librarian, Dr. Hays, a calendar is being made as fast as the limited means at his disposal will permit, and, when that is completed, it is hoped that it will be printed as a useful guide to the miscellaneous matter collected here. Sparks, Hale, Ford, Parton, Fisher and others who have written about Franklin have used them, but even the most industrious student may well be appalled at the labor required to master all the contents of these bulky volumes, representing Franklin's long and many-sided activity.

He kept copies of most of his own letters and the originals addressed to him, often indorsing on them the heads of his replies. These volumes contain papers from 1735 to 1790—the first forty-four volumes, letters to him; the forty-fifth, copies of his own letters; the forty-sixth, his correspondence with his wife; the forty-seventh and forty-eighth, his own letters from 1720 to 1791; the forty-ninth, his scientific and political papers; the fiftieth, his other writings—notably his Bagatelles, those short essays which had such a vogue, and are still read; the fifty-first, poetry and verse, his own and that of others, no doubt selected by him for use in his publications; the fifty-second, the Georgia papers—he was agent for that colony; and the remaining twenty volumes all the multifarious correspondence, other than official, mostly during his long stay in France, his various public offices at home and abroad, his enormous correspondence about appointments from men of all nationalities, who wanted to come to America, under his patronage, to fight, to settle, to teach, to introduce their inventions, for every imaginable and unimaginable purpose.

Both in England and France he kept all notices of meetings, such as those of the Royal Society, and other scientific bodies of which he was a member, invitations, visiting cards, notes, business cards, etc., and at home he kept copies of wills, deeds, powers of attorney, bonds, agreements, bills and drafts, checks, bills of lading, public accounts and even certified copies of acts of Congress and account books, and, in addition, Temple Franklin left eight volumes of letters to him from 1775 to 1790.

In this mass of material his biographers have found much that was of value, but there remains almost untouched the interesting correspondence of his friends in England during the years before and those of the War of Independence. There are examples of his own clever *jeux d'esprit* in the 'Intended Speech for the Opening of the Parliament in 1774,' in which the King himself is made to foretell the 'seven or ten years' job' that his 'ministers have put upon him to undertake the reduction of the whole continent of North America to unconditional submission.' His friend Hartley sent it to him in 1786, when the prophecy had been fully realized. Again in 1778 he received a full report of the famous dying speech of Chatham and of that of Lord Shelbourne in his defense of the

American cause, speeches which have hardly been reported in full.

During these eventful years his correspondents in England and in the Colonies kept him well informed both of the actions and plans of the government and of the opposition. Some of these may be of interest as showing how earnestly both sides were presented to him, that he might use his influence to maintain peace. Priestley, who was then the secretary of Lord Shelbourne, writes from London in February, 1776, with a due report of political and scientific information, and Lee and Wayne write to him during the campaign which was to end in Burgoyne's surrender, and thus contribute largely to the alliance with France, which owed so much to Franklin's influence not only with the French court and French statesmen, but with the philosophers and the people.

His correspondence in Paris is a perfect picture of the time. One day he gets an invitation to attend experiments in electricity from a correspondent, Brogniart, who reports the successful treatment of sick people by electric fluid in 1778, and soon after the Curé of Damvillers asks him for a cure for dropsy for one of his parishioners.

His correspondence came from England and from all parts of the continent and from the West Indies in an unending stream.

A very curious letter is one from Richard Penn, dated London, October 20, 1778, which I think has never been printed, in which he says:

"I should think myself infinitely obliged to you if you could point out to me in what manner I could procure, either from America or in any other way, a temporary subsistence. I have not a doubt but that in time matters will turn out much to the advantage of everybody concerned and connected with that country."

When it is remembered that the hostility of the Penns to Franklin was so strong that Governor John Penn declined to be patron of the American Philosophical Society because it had chosen Franklin for its president, and that Richard Penn had been Lieutenant-Governor (as deputy for that uncle and his brother) from 1771 to 1773, it must have been difficult for Franklin not to feel that such a letter from such a man at such a time was indeed a tribute to his position, achieved solely by his own efforts.

It is well that this venerable society, so largely the result of his labors, should be made the custodian of the papers that follow almost his daily thoughts, and it is to be hoped that the preparation and publication of a calendar showing their contents may be completed at no distant day, certainly by the two hundredth anniversary of the birth of our founder, and thus perpetuate his memory.

Afternoon Session, 2 o'clock.

Vice-President Scott in the chair.

Further Notes on the Santa Cruz Edentates: Professor William B. Scott, of Princeton.

The fossil edentates of the Santa Cruz beds in Patagonia differ very notably from the forms now living in South America. Of the three edentate orders represented in the Santa Cruz, only one, the armadillos, has persisted to the present day, while no trace of the true sloths or of the anteaters has yet been found. The ground-sloths are very numerous and form very interesting evolutionary series leading to the giant species of the Pampean, while the armadillos and glyptodonts are, for the most part, away from the main line of descent.

An Attempt to Correlate the Marine with the Non-marine Jurassic and Cretaceous Formations of the Middle West: Professor John B. Hatcher, of Pittsburgh,

The Evolution and Distribution of the Proboscidea: Professor HENRY F. OSBORN, of New York.

A New Fresh-Water Molluscan Faunule from the Cretaceous of Montana: Mr. T. W. STANTON, of Washington. (Introduced by Professor W. B. Scott.)

This paper describes and discusses a collection of invertebrate fossils from near Harlowton on the Musselshell River, Montana, collected in 1902 by Dr. Farr and Mr. Silberling, of the Princeton University expedition.

The species are only six in number, but with one exception each is represented by abundant and well-preserved examples. Of these two are referred to *Unio*, two to *Goniobasis*, one to *Campeloma* and one to *Viviparus*. The study of these fossils, in connection with their reported stratigraphic position and a general discussion of the early Cretaceous and late Jurassic non-marine formations of the region, leads to the conclusion that they are probably from a horizon near the base of the Upper Cretaceous, or possibly as low as the Lower Cretaceous.

Hints on the Classification of the Arthropoda, the Group a Polyphyletic One: Professor ALPHEUS S. PACKARD, of Providence.

Anatomy of the Floscularidæ: Professor THOMAS H. MONTGOMERY, JR., of Philadelphia.

The Earliest Differentiations of the Egg: Professor EDWIN G. CONKLIN, of Philadelphia.

In the living eggs of fresh-water snails important differentiations are recognizable before the eggs begin to divide. Soon after the formation of the polar bodies clear non-granular protoplasm accumulates at the animal pole and spreads down over the surface of the egg towards the opposite pole. About three fourths of the surface of the entire egg is covered by this clear protoplasm, which gives this portion of the egg a milky appearance, while about one fourth of the egg surface at the vegetative pole is not covered by this protoplasmic layer and is bright yellow in color. These two portions remain distinct throughout the subsequent development of the egg, the protoplasmic area giving rise to the ectoderm, the yellow one to the endoderm and mesoderm. The germ layers are, therefore visibly outlined in the unsegmented egg. In these eggs the type of asymmetry of the adult snail (whether dextral or simitral) is also predetermined, probably while the egg is still in the ovary. The chief axis of the future animal is also marked out in the egg, and is probably to be traced directly back to the egg of the previous generation. In this case, therefore, these axial relations are probably continuous from generation to generation.

Some Properties of Nickel: Mr. JOSEPH WHARTON, of Philadelphia.

A Résumé of the Composition of Petroleum from Different Fields: Professor CHARLES F. MABERY, of Cleveland.

This paper explained the composition of petroleum from different sources, and described the series of hydrocarbons that make up the great body of petroleum. In Pennsylvania oil the series C_nH_{2n+n} predominates in the lower distillates and continues to include solid paraffine hydrocarbons. Pennsylvania oil also contains the series C_nH_{2n} and the series C_nH_{2n-2}, and probably also series still poorer in hydrogen in the less volatile portions.

Ohio oil has much the same composition, with the addition of the series C_nH_{2n-4}, and probably other series still poorer in hydrogen.

California oil does not contain the series C_nH_{2n+2} so far as known, but contains the other series mentioned.

Canadian oil contains all the series mentioned, with larger proportions of the series poor in hydrogen.

All petroleums contain compounds of oxygen, nitrogen and sulphur, but in variable amounts, very small in Pennsylvania oil, large in California, Ohio and Canadian crude oils.

A summary of what is known concerning the origin of petroleum was given, with some suggestions based on recent knowledge of its general composition.

SATURDAY, APRIL 4.

Morning Session, 10 o'clock.

President Smith in the chair.

A Further Classification of Economies: Professor Lindley Miller Keasbey, of Bryn Mawr, Pa.

An economy is a system of activity whereby the utilities inherent in environment are, through utilization, converted into actual utilities.

These economies can be distinguished from one another in two ways: First, according to the motive making for utilization, and, second, in accordance to the means employed in the process. They may be classified as the automatic, characteristic of plants; the instinctive, characteristic of animals; the rational, characteristic of human life.

The rational economy may be subdivided into the natural, characteristic of savages; the proprietary, characteristic of barbarians; and the commercial, characteristic of western civilization.

Some Features of the Supernatural as Represented in Elizabethan and Jacobean Plays: Professor Felix E. Schelling, of Philadelphia.

The Hamites and Semites in the Tenth Chapter of Genesis: Professor Morris Jastrow, Jr., of Philadelphia.

The Most Insidious Cause of Error in Quantitative Chemical Research: Professor Theodore W. Richards, of Cambridge, Mass.

Experiments are recorded and quoted showing that most if not all crystals deposited from solutions contain included mother liquor. The experiments show also that before this mother liquor can be eliminated by pulverization, the absorption of water from a moist atmosphere begins to augment appreciably the weight of the substance. It is pointed out that this absorption can not be overcome in the case of hydrated salts without a loss of water of crystallization also. Hence hydrated salts can not be accurately weighed according to any usual procedure. In the case of anhydrous salts the elimination of absorption is easy, but in order to remove included water the cell walls enclosing it must be disintegrated. Mechanical, thermal and chemical methods of such disintegration are classified and applied to the preparation of pure materials. It is pointed out that other impurities are usually included with the solvent in the invisible cells, and that these other impurities must never be forgotten in the course of the further purification. Finally, it is suggested that these almost infinitesimal enclosed impurities might be used as a clue to the manner of growth of natural minerals, and hence to the mechanism of geophysical processes.

The Warfare against Tuberculosis: Dr. Mazÿck P. Ravenel, of Philadelphia.

All efforts at the eradication of tuberculosis to be successful must be based on the fundamental fact of its communicability, and in the main it is to be treated as the other contagious diseases, though the restrictions need not be so severe.

Two parties are to be considered, the tuberculous persons and the community, and while the former are entitled to every consideration and attention, the good of society in general must be the principal consideration which guides our action. Fortunately, the interests of the two parties are not irreconcilable and much can be done by education to smooth the difficulties which lie in our path.

There should be in every state and in every large city societies whose objects are the study of methods of prevention and the dissemination of such knowledge in short, plainly written tracts among the people.

In addition to this, boards of health should issue circulars constantly giving such information and advice. At present only twenty-two states and seven cities issue such circulars and recommendations, while five states have societies and five cities have local societies for the prevention of tuberculosis.

These societies can do much good also in shaping legislation. States and cities should have uniform laws regarding expectoration in public conveyances, buildings and on sidewalks; overcrowding of factories and tenement houses, the construction of such buildings as regards light and ventilation, and the employment of children under age.

Health officers should have the power to force ignorant and vicious tubercular persons who persist in reckless expectoration into hospitals provided for them by the public. There should be compulsory notification and registration of persons suffering with phthisis, and apartments occupied by such persons should be thoroughly disinfected periodically, and always after death or vacation of the premises before new tenants are allowed to enter them.

The urgent need is for institutions in which the sick can be cared for and instructed. These should be of two types—sanatoria, built in open country districts in regions known to be specially adapted to the treatment of tuberculosis, and, second, hospitals for the hopelessly ill and destitute, where the maximum of comfort can be given to them and where they will cease to be sources of infection to their families and the public in general.

In spite of the enormous expenditure which would be involved in providing hospital accommodations for the indigent tuberculous, it would cost less than the present money loss to the country from deaths alone, and in a few years we could confidently expect a marked decrease in the disease.

SCIENTIFIC BOOKS.

The Diamond Mines of South Africa. Some Account of their Rise and Development. By GARDNER F. WILLIAMS. New York and London, The Macmillan Co. 1902. Pp. 681. With 491 illustrations, 29 photogravures and 11 maps.

The most important volume that has ever appeared upon the diamond fields of South Africa, or in fact upon diamond mining in general, is that from the pen of Mr. Gardner F. Williams, General Manager of the De Beers Consolidated Mines. There is no doubt that the late Hon. Cecil J. Rhodes, who died during the early part of 1902, would have been deeply interested in this volume, and it was the desire of the author that he should see it—little realizing that this great organizer would so soon have passed away. But it must also be recognized that it was through the directing capacities and experienced mining knowledge of Mr. Williams himself that the De Beers Mines were managed in such a way that the cost of production was gradually brought down to the lowest possible limit; that theft was almost entirely done away with; and that each year had shown a decrease in the cost of production, and a greater security of these mines as an investment. To the union of these two men—one as the organizer, Mr.

Rhodes, and the other as the manager, Mr. Williams—is due a financial corporation laid out and conducted on lines of such extent and permanence that it surpasses almost any other in existence. To the credit of both be it said that they never used their positions for speculative dealings in the stock, and that neither of them ever lost faith in their great enterprise.

The title, 'The Diamond Mines of South Africa,' is slightly misleading, as the book refers only to those mines owned by the De Beers Consolidated Co., and omits some other mines in the Transvaal and the Orange Free State not under their management or ownership. These, however, represent less than three per cent. of the entire output of South Africa.

The volume opens with a chapter on the ancient Adamas, illustrations being given of all the noted historical diamonds. The second chapter treats of the traditional Ophir Land, and the facts tending to prove that the famous King Solomon's mines were in Rhodesia. To support this view, illustrations are given of the gold ornaments found in the district, and the historical evidences of the great ruins at Zimbabwe, Khami and Insiza. This theory is also sustained by John Hays Hammond, notably in a lecture delivered before the American Association for the Advancement of Science, Washington, on January 3, 1903.

It is doubtful if any one else living possesses so many facts as Mr. Williams concerning the original discovery of the African diamond mines, the early pioneers of the district and other historical data, which, if they had not been preserved here, would have been soon forever lost. These are presented in chapters III. to VII., entitled, respectively, 'The Pioneer Advance,' 'The Discovery,' 'The Camps on the Vaal,' 'The Rush to Kimberley,' and 'The Great White Camps.' These chapters give a connected and vivid account of the history of the whole region, from the Cape to the hinterland—its early settlement, its slow and scanty development through two centuries and its sudden and marvelous period of change and growth in the last thirty years.

In the 'Pioneer Advance' we have an interesting sketch of the early conditions of the Cape Colony; of the expeditions under enterprising Dutch governors and explorers, in search of the golden land of traditional Ophir, ever disappointed and turned back; of the decline of interest and of hoped-for prosperity; of the British seizure and occupation. Then follows a striking account of 'the Great Trek,' when the Boer farmers, preferring a fresh start in the wilderness to the acceptance of an alien rule, went forth to found new commonwealths on the upland veldt beyond the Vaal. The features of the country, and the strife with negro savages, are forcibly pictured; and the record, if rude, is yet heroic, and appeals very powerfully to the best traditions of our own history. After a generation had passed, in the calm, old-fashioned pastoral life of the Dutch republics, came 'The Discovery'—the first diamond accidentally picked up in the gravel of the Vaal, in 1867. In due time followed an invasion of prospectors and diamond-hunters, gathering along the valley—'The Camps on the Vaal'—the period of the 'river diggings.' Soon after came the finding of other and richer beds on the uplands to the east, and the 'Rush to Kimberley' set in, in the early 70's. This marvelous gathering, from every part of the world, is most vividly pictured, and the 'Great White Camps' that sprang up as though by magic, to give place to permanent cities and gigantic industries.

Chapters VIII. to XV. are taken up with the diamond mines themselves; chapter VIII., on 'The Opening of the Craters,' describes the early stages of mining operations, in which scores and hundreds of little private claims were worked from the surface down, until with increasing depth, the intervening roadways and then the great surrounding 'reef' or wall-rock, began to fall and cave in, so that an entire change of method was seen to be ere long inevitable. The next chapter, on 'The Moving Men,' introduces us to the history and personality, the plans, purposes, efforts and rivalries, of the two leading figures in the subsequent development of the De Beers and Kimberley mines—Cecil Rhodes and Barney Barnato—whereby was brought about

the consolidation of these extraordinary properties. Chapter X.—' The Essential Combination '—describes this result—the great achievement of Cecil Rhodes—in its history and in its bearings, both upon the mines themselves and upon the future of all South Africa.

The next chapter, on ' Systematic Mining,' gives full accounts of the methods then adopted, and now in use, for the operation of the mines in a comprehensive and economical manner. Here Mr. Williams is describing his own particular work; as the whole vast connected scheme of exploitation, under which such splendid success has been attained in the past fourteen years, and which is adapted to the further prosecution of the work for an indefinite time to come, is of his planning and execution. The modesty, however, with which he refers to himself and his unique achievements is remarkable, and bears the stamp of genuine greatness. Without the skill and ability which Mr. Williams has shown in the designing and operating of the present system, the great consolidation effected by Mr. Rhodes and his group of financial supporters might have failed of a successful result, or at least never have attained the far-reaching importance that it has.

This chapter is largely technical, and can not be readily outlined in a manner intelligible to the ordinary reader—dealing as it does of necessity with conditions, terms and processes belonging to mining engineering. In a general way, however, it may be described as a process of undermining instead of excavating. The first method had been by digging down from above, by a host of independent claim-owners, individual or corporate. The mines thus became immense pits, traversed by roads that came to stand up as narrow ridges, and walled by the vertical surrounding ' reef ' of basalt and shale. As already stated, however, first the intervening roadways between the claims caved in and became useless, and then the reef-wall began to fall and cover great areas of diamond-bearing ' blue-ground ' with thousands of tons of broken rock. Various tentative devices were tried for continuing the working under such conditions, but they were plainly temporary and destined to ultimate failure. Only by consolidation of all the claims could a general and comprehensive plan be adopted for operating the whole. This was brought about by Mr. Rhodes, first for the De Beers mine; next, after much contest with Mr. Barnato, by the union of this with the Kimberley mine, in which the latter had a controlling interest; then by both in cooperation, by the taking in by the great corporation, the ' De Beers Consolidated Mines, Limited,' of the Bultfontein and Du-Toits-pan mines, which together now form the wonderful group of volcanic ' necks ' or ' craters ' (though the latter term is hardly correct) around the city of Kimberley.

This took place in 1888; and by the beginning of 1889 Mr. Williams, as the general manager of the whole, began his new method of working. Shafts were sunk in the solid rock outside of the mine areas, and horizontal galleries run from these into the 'blue-ground' of the mines, beneath all the fallen mass that covered so much of the former workings. The blue-ground was excavated along galleries branching from these again, and thus a given area on a given level was worked out, and the overlying mass of fallen rock, its support largely removed, was allowed to sink down and fill up the empty galleries and chambers. The same process was then repeated on another level, thirty or forty feet below, and a new set of galleries opened and emptied, and whatever ' blue-ground ' also had been left as supports, on the former level, was now taken out from below. It will be seen that this process admits of being carried on indefinitely downward, so far as the mechanical difficulties are concerned. The extraction is done, in each level, from the rock-wall toward the interior; and in each mine, several levels are being worked at the same time, by methods explained in the account. The extensive machinery for hoisting the material removed and for pumping out the water that accumulates, etc., is also here described and illustrated.

Chapter XII., on ' Winning the Diamonds,' is less technical than the preceding, and full of curious interest. The ' blue-ground ' rock of the necks or chimneys was at first broken

up with shovels, then rudely washed and the residue picked over by hand. The various steps and stages of progress in its treatment are described, down to the wonderfully complete, rapid and accurate machine processes now employed. The rock was found to disintegrate and break up by a few months' exposure to the air, sun and rain; and thus most of the former crushing is dispensed with. The rock brought out is hauled by a very perfect system of traction to the 'floors'—large areas of smoothly rolled ground, covering several hundred acres—and there spread out, about a foot in thickness. Various processes, of steam-harrowing, occasional watering in dry times, etc., are employed to accelerate nature's effect. The removal to the washing machines, and in part to crushers, and all the devices for sorting and concentrating, are described in detail, until the last stage is reached, when the heavy concentrates are fully separated, and ready to be picked by hand. Here it appeared as though the point had been reached where machine processes had to cease and human agency alone could avail. But no! After many years of hand-picking, the discovery was made by one of the employees, Mr. Fred. Kirsten, that diamonds would adhere to grease, while the other minerals of the concentrates would not. A few experiments proved conclusive; and soon all hand-sorting was replaced by machinery—slightly inclined tables coated with a layer of grease. These are vibrated as the concentrates are made to pass over them with a current of water, and every diamond is retained, while the garnets and other heavy minerals pass on! No more simple and complete device has ever been discovered, for the saving of time, labor and loss. The diamonds thus separated are afterwards boiled in a hot solution of soda, and are then ready for the company's office and the valuator.

The succeeding chapter tells of 'Obstacles and Perils' encountered in the working of the mines, and is a graphic presentation of this aspect of the subject. The earlier dangers were chiefly from reef-falls and cave-ins; after the new methods were introduced these became unimportant. Occasional slight explosions, due to carelessness of workmen, and one disastrous fire, of unknown origin, but probably from the same cause, are described, the latter in a very vivid and feeling way. The 'mud-rushes' are the most serious liability of late; and the methods employed to prevent them are ingenious and interesting.

Chapter XIV., on 'The Workers in the Mines,' is one of great general interest, describing the conditions and regulations of life and work in the vast subterranean hive of activity, and the arrangements for housing, feeding and controlling the great heterogeneous army when above ground. About one sixth of the employees are white men, largely from the mining districts of England, though there are many Afrikanders, and a sprinkling from nearly every land on the globe. The rest, some eleven thousand, are native blacks, representing almost every tribe south of the equator, some coming from distances as great as a thousand miles. Mr. Williams gives a most interesting estimate, based on conspicuous facts, of the industrial capacity of the negro—one that impresses an American with surprise. The steadiness, persistence, contentment and capacity shown by these thousands of laborers, fresh from their native savagery, is in utter contrast to the shiftless and indolent character of the negro so largely seen in the New World, and so generally attributed to the race as such. As a sociological study this subject of the experience of the De Beers Company with African labor, on a grand scale and through many years, is worthy of most careful attention by anthropologists and philanthropists.

The moral and physical well-being of these natives are well guarded by the company in its great system of 'compounds'—walled enclosures, carefully constructed and steadily watched, where the laborers are kept in a sort of paternal confinement during their period of working. Every one engages freely for a time not less than three months, and is then at liberty to leave or renew—the great majority choosing the latter, and many remaining for years. Liquor is rigorously excluded, as ruinous to all steady or reliable service.

Good food is furnished at low rates and good wages paid. Strict sanitary arrangements are provided and maintained; and the whole of Sunday and the Saturday half-holiday, save for a little indispensable work, are granted regularly. It was found that with three shifts of men each working eight hours a day diamonds could be mined for less per head than with a twelve-hour day at the same rate of pay per day. No women may be employed in mine work, and no boys under twelve. These broad and humane provisions are an impressive object-lesson to employers and corporations not so far away.

The natural result is industry, contentment and monumental success. Much very interesting matter is given as to the ways and usages of the different tribesmen. On Sundays there is considerable missionary work done among them, and much visiting, games and music among themselves; all are cheerful and friendly, tribal enmities and feuds being excluded from the 'compound.' The native music is in itself a curious and fascinating subject, but one that can not be enlarged upon here. The De Beers compounds, however, surely present a most interesting field for study in many ways, alike in ethnology and sociology.

The succeeding chapter deals with 'The Mining Towns,' and is an account of the modern cities and suburban communities that have grown up around the diamond mines. Kimberley is described and illustrated, in its various stages, from the camp of tents and shanties of thirty-two years ago, through its next phase of brick and corrugated iron, to the up-to-date city of recent years, with its hospitals, churches, club-houses, library and school of mines, its gardens and water-works, and its refined houses surrounded with foliage and flowers. The tale is a wonderful one, though paralleled by much in our own western development, with the difference that in the case of Kimberley there is ever present as the leading factor the one great corporation, and its master-spirit, Mr. Rhodes.

Chapter XVI., on 'The Formation of the Diamond,' is the one possessing the highest interest in the book, from a scientific point of view. Both to the general reader and to those who have followed the very active discussion among geologists through some years past on this subject, Mr. Williams's full and clear summary of the facts and theories as to the whence and the how of this unique store of precious gems, will possess great interest. It may cause surprise, however, and disappointment to find that his closing word is practically that we do not know! He finds in the several theories advanced many points of striking suggestion and some of strong probability, but nothing yet that fully meets and explains the various facts encountered.

Some points are well established; others are eliminated; others still are awaiting further study. The 'necks' are in some sense volcanic chimneys, but their filling has taken place at no very high temperatures—more after the manner of mud-volcanoes than of true volcanoes; the 'blue-ground' is a breccia of fragments, and not a decomposed lava; the diamonds were not found in it, but carried up with it from below. In these conclusions Mr. Williams agrees more with the English scientists, Bonney and Crookes. On the other hand, he does not agree with Sir William Crookes in attributing to the diamonds an origin similar to the artificial diamonds of Moissan, formed from carbon in melted iron under enormous pressure and heat. Here Mr. Williams gives some facts of his own, opposed to Crookes' theory. The latter, arguing for a crystallization at great depths from molten iron, at very high temperature, had cited the explosion, or violent rupture, of African diamonds, said to occur not infrequently, as an evidence of the strain and pressure under which they had been formed. Mr. Williams states that this spontaneous breakage is exceedingly rare, and that in fact he had hardly ever met with it. He then describes some original experiments as to the presence of iron or its oxides as the coloring matter of the yellow and brown diamonds, which Crookes had cited as an evidence of their origin from fused iron far down in the earth's crust. 'These experiments were made upon a magnetic separating machine, the field magnets of which attracted any mineral which

contained iron in a metallic or oxidized state'; but no slightest response was shown under the most powerful action of the machine, and with diamonds of the most marked yellow and dark tints. If they contain iron at all, its amount must be infinitesimal.

That the 'blue-ground' is not a decomposed lava, and has not been greatly heated since the diamonds have been in it, is shown by experiments of Herr Luzi, at Leipsic (*Ber. d. Deutschen Chem. Gesell.*, 1892), which are here described, but which have not attracted the attention that they deserve. He fused some of the 'blue-ground' in a graphite crucible at 1770° R. (4014° F.) and then introduced a diamond crystal, and closed and reheated the crucible. The diamond, previously smooth and brilliant, was found to have been corroded and etched, *i. e.*, partially dissolved, by the fused silicate mixture, in which it had been originally embedded. Mr. Williams then asks, How is it possible that most of the crystals found are bright and polished, with no trace of such corrosion, if the blue-ground has ever been in any condition of fusion from heat, like a lava.

The latest reference of the diamonds to an origin in an eclogite rock at very great depths, suggested by Professor Bonney, in consequence of some having been found enclosed in boulders of that rock in the blue-ground of the Newland's mine, is duly considered, and some questions raised in regard to it by Professor Bonney himself are stated. Mr. Williams expresses no positive opinion as to this view, the facts observed at the Newland's mine not having come under his notice at De Beers or Kimberley; and, as before stated, his latest word is non-committal.

The next two chapters, on 'The Diamond Market' and 'Cutting and Polishing,' are abundantly interesting, but can not be enlarged upon in this sketch. Suffice it to say that they are full and accurate accounts, freely illustrated, of all the methods of assorting and valuing the diamond-product, together with notes on the other diamond regions of the world and on the sale and distribution of the stones in commerce; and in the eighteenth chapter, of the history and development of the art of cutting, and of the present methods and principal seats of the industry.

The closing chapter, 'An Uplifting Power,' is a remarkable presentation, from the Rhodes-De Beers standpoint, of the influence of the great diamond fields on the development, progress and civilization of the Dark Continent. The opening of mines; the building of cities; the laying out of railroads; the conversion of an arid wilderness into a populous and progressive land of civilized institutions; the repression of bloody tribal warfare; and the extension of British control and influence far toward the equator, and ultimately, in vision, 'from the Cape to Cairo'—all these have resulted largely from the Kimberley discoveries. They were the dream and the ambition of Mr. Rhodes, who bent all his truly wonderful energies toward their accomplishment, seeking wealth and power, as Mr. Williams emphatically contends, not as ends in themselves, but as means to the realization of a grand historical idea. The account is both impressive and inspiring, and evidently contains a large amount of truth. Of the other and darker side, nothing is said; the 'Jameson raid' is not mentioned and the recent war is but slightly alluded to, save in the account of the siege, in the appendix, and then only in its local incidents. It is but just to Mr. Williams, however, to recall that he is writing about the De Beers mines, and not about the history of South Africa in general, though the two are closely connected, as he himself has shown. His estimate of Mr. Rhodes is exceedingly high and his sympathy with him is profound, but he writes in a spirit of great breadth and fairness that impresses the reader very favorably.

The volume closes with an appendix, of which the first part is a history of the siege of Kimberley. This is a most vivid and even thrilling account of the four months' investment; the conversion of the mine-workers into a garrison, and of the tailing-heaps into redoubts; of the turning of all the machinery and resources of the great mining plant into one and another means of defense; of the ever-ready energy of Mr. Rhodes to meet new

emergencies as they arose, which were often beyond any means of military or official solution.

The remaining parts of the appendix give detailed statements about the winding engines, pumping plant and the relative value and efficiency of various coals, African and English; and the last section gives a tabular statement of the yield of the mines, year by year, since the consolidation in 1888. This is a most remarkable body of statistics, well worthy of careful examination.

The report volume would be much more valuable if a single good map of the region dealt with so extensively in all the historical chapters accompanied it. Two or three little maps of special localities, and one of the railroad systems, in part, are all that are given. The book has a good index, but is wholly lacking in a table of contents, either at the beginning of the volume or at the head of each chapter. This again is a great defect.

Mr. Williams has written a great book that reads like a romance; and the tale of Sinbad the Sailor and his valley of diamonds is as nothing compared with the story of the discovery of mines which up to the present have produced more than $500,000,000 worth of uncut diamonds—with little diminution of the output in sight to-day; of the building of cities and railroads in the wilderness; of mines equipped with machinery made in Chicago and London—machinery that is almost human in its accuracy. The literature quoted in the volume is an admirable exposition not only of the history of the mines, but of the entire South African region. From the finding of the diamond by the children of Samuel Jacobs, the handing of the crystals by van Niekerk to a traveling trader, John O'Reilly, and the identification of it by Lorenzo Boyes, to the working of a shaft to a depth of 1,400 feet, is a story without parallel. The wonderful finding of the diamond on the Vaal River on the Gong Gong, and discovery at Kimberley only a few years later, are described so vividly as to have an interest such as few works on travel afford us. Here we have also the story of the thousands of claims that seventeen years later were consolidated into a great corporation through the genius and organizing powers of Cecil J. Rhodes.

The discovery of diamonds in South Africa has done more to open up that country than all other industries together, for it was the encouragement from the sale of diamonds that precipitated the Matabele war which led to the discovery of gold in the Transvaal, in value many times exceeding that of the diamond fields of the region. The change from a multitude of individual claims, that gave the district the appearance of gigantic ruins, to the working by the shaft system was organized under Mr. Williams's administration. The employment of contract and native labor, the latter often obtained more than 1,000 miles from the mines, and the utilization of the most approved mining machines, replacing the old wheelbarrows and cradles of the earlier days, meant that the cost of mining diamonds was reduced to a fraction of what it was before, and that there was nothing to be feared from the lowering of the price by dealers who purchased stolen material. When we realize that South Africa has recently produced in one decade more than ten times the value of all the diamonds ever found in Brazil, and that this immense production dates from the discoveries begun in 1867, we may realize in a slight degree how great a change has taken place in the world's diamond production within the lifetime of a single generation.

GEORGE F. KUNZ.

Vergleichende chemische Physiologie der niederen Thiere. Von Dr. OTTO VON FÜRTH, Privatdocent und Assistent am physiologisch-chemischen Institut der Universität Strassburg. Jena, Gustav Fischer. 1903.

The progress which recent years have contributed in the study of the comparative morphology and physiology of animals has largely been emphasized along non-chemical lines. This is due not so much to an absence of chemical data which are of interest and importance in animal biology as to the difficulty which the student has experienced in collecting and correlating what has already been ascertained in this direction. There is no

dearth of observations which may be expected to throw light on the chemical reactions and metabolic processes of the lower animals; but they are scattered so widely through the literature, and they appear so isolated in their bearing, that an adequate systematic presentation of the comparative chemistry of animals has never been attempted before the publication of the book by Dr. von Fürth. Indeed, it must be acknowledged that few individuals have acquired the wide biological experience and chemical training which are demanded for the successful accomplishment of such a task.

In the opinion of the writer, Dr. von Fürth's book is one of the most important recent additions to the literature of physiological chemistry. Its value lies not only in the compilation of an orderly digest of an enormous number of scientific papers, most of which have apparently been consulted in the original; equally satisfactory is the critical attitude which has been assumed in editing the heterogeneous experimental material. And it is, perhaps, not so much in the classification of facts and the orderly treatise on comparative physiological chemistry, as in the exposition of the deficiencies of our knowledge, that the biological investigator will find the work helpful and stimulating. In almost every chapter the author has pointed out lines of experimental inquiry—biochemical problems which demand solution. What has already been attained makes it clear that we may expect still greater advances in biology to follow the more extensive application of comparative chemical methods in this domain. A review of the current text-books will readily convince one upon what slender basis many chemical considerations, handed down without verification from writer to writer, really rest. As von Fürth remarks, too many have contented themselves with the principle:

"Nur muss man sich nicht allzu ängstlich quälen;
Denn eben wo Begriffe fehlen,
Da stellt ein Wort zur rechten Zeit sich ein.
Mit Worten lässt sich trefflich streiten,
Mit Worten ein System bereiten,
An Worte lässt sich trefflich glauben,
Von einem Wort lässt sich kein Iota rauben."

New experiments and fresh facts are wanted; and the encouragement which this volume offers will bring results. When, for example, the physiological chemist shall be able to differentiate the proteid substances according to their chemical structure—a possibility which recent advances make by no means improbable—then we may truly group like with like and classify protoplasmic masses according to their chemical make-up. Then we may hope to accomplish along chemical lines also what the morphologists have long attempted with much success in determining the biological relationships of animals. In merely pointing out the gaps in our present knowledge von Fürth has done a useful service.

Von Fürth's book is not adapted to detailed review in this place. In an introductory chapter a résumé of the essential features of organic chemistry and of the physiologically important types of organic compounds has been given with unusual success. This will be a welcome recapitulation to the biologist unaccustomed to thinking in chemical ways. Succeeding parts deal with the chemical composition of protoplasm, the blood, respiration, nutrition, excretion, animal poisons, specific secretions, the muscles, the connective tissues, reserve and skeletal constituents, products of the sexual glands, and the chemical environment of animals. In each chapter an introductory historical sketch leads to detailed consideration of the topic in connection with the various groups of the invertebrates. The references to the literature are given in detail, experimental methods being included in many cases.

The completion of a task such as von Fürth has accomplished so well should not be made the occasion for unfavorable criticism. A number of typographical errors, aside from those noted in the appendix, remain uncorrected. It seems unfortunate that in Strassburg the work of American physiologists is still cited and known only through German abstracts. Dr. von Fürth deserves congratulation for his contribution to biochemical literature.

Lafayette B. Mendel.
Sheffield Scientific School,
Yale University.

SCIENTIFIC JOURNALS AND ARTICLES.

THE *Bulletin of the Torrey Botanical Club* for February contains a paper 'On Atavistic Variation in *Œnothera cruciata*,' by Hugo de Vries; 'Nova Ascomycetum Genera Speciesque,' by Frederic E. Clements; 'New Species of Fungi,' by Charles H. Peck; 'A Fossil Petal and a Fossil Fruit from the Cretaceous (Dakota Group) of Kansas,' by Arthur Hollick; 'Notes on Antillean Pines, with Description of a New Species from the Isle of Pines,' by W. W. Rowlee; 'The Polyporaceæ of North America, II., the Genus *Pyropolyporus*,' by William Alphonso Murrill; and the usual instalment of the 'Index to Recent Literature Relating to American Botany.' The March number consists mainly of 'Studies in Plant Hybrids: The Spermatogenesis of Hybrid Cotton,' by William Austin Cannon, but includes a biographical sketch of Dr. Timothy Field Allen by N. L. Britton; 'Studies in the Asclepiadaceæ—VII., A New Species of *Vincetoxicum* from Alabama,' by Anna Murray Vail; 'A New Species of *Waldsteinia* from Idaho,' by C. V. Piper; and the 'Index to Recent Literature.'

THE February number of *Torreya* contains 'Notes on Southern Ferns,' by L. M. Underwood; '*Trichomanes Petersii* Found Anew,' by A. B. Seymour; 'A Unique Climbing Plant,' by Roland M. Harper; 'An Undescribed *Eleocharis* from Pennsylvania,' by N. L. Britton, and 'A Key to the North-American Species of *Stropharia*,' by F. S. Earle. Carlton C. Curtis reviews Kraemer's 'Course in Botany and Pharmacognosy,' and this is followed by the 'Proceedings of the Club' and news items.

Torreya for March includes 'Vital Persistency of *Agave Americana*,' by S. B. Parish; 'A Key to the North-American Species of *Lentinus*—I.,' by F. S. Earle; 'The Pubescence of Species of *Astragalus*,' by Francis Ramaley; 'Insect Visitors of *Scrophularia*,' by T. D. A. Cockerell; and 'Some Interesting Hepaticæ from Maine,' by Caroline Coventry Haynes. C. C. Curtis reviews MacDougal's 'Influence of Light and Darkness upon Growth and Development,' and the number is completed by the 'Proceedings of the Club' and news items.

SOCIETIES AND ACADEMIES.

THE NATIONAL ACADEMY OF SCIENCES.

THE following papers were either read or presented by title at the stated session of the National Academy of Sciences held at Washington on April 21, 22 and 23:

HENRY F. OSBORN: 'An Estimate of the Weight of the Skeleton in the Sauropoda, or in the Sauropodous Dinosaurs.'

HENRY F. OSBORN: 'New Characters of the Skulls of Carnivorous and Herbivorous Dinosaurs.'

HENRY F. OSBORN: 'Models illustrating the Evolution of the Amblypoda, also of the Dinosaur *Diplodocus*, together with a Theory as to the Habits of the Sauropoda.'

GEORGE F. BARKER: 'Radioactivity of Thorium Minerals.'

J. M. CRAFTS: 'The Law of Catalysis in Concentrated Solutions.'

J. M. CRAFTS: 'The Standardization of Thermometric Measurements.'

GEORGE E. HALE: 'The Rumford Spectroheliograph of the Yerkes Observatory.'

LEWIS BOSS: 'The Determination of Standard Right-ascensions free from the Personal Equation for Star-magnitude.' (With stereopticon illustrations.)

R. A. HARRIS: 'On the Semi-diurnal Tide of the Northern Part of the Indian Ocean.' (Introduced by Cleveland Abbe.)

ARTHUR L. DAY: 'The Melting Point of a Simple Glass.' (Introduced by G. F. Becker.)

THEODORE GILL: 'Biographical Memoir of J. E. Holbrook.'

GEORGE F. BARKER: 'Biographical Memoir of Matthew Carey Lea.'

S. F. EMMONS: 'Biographical Memoir of Clarence King.'

JEFFRIES WYMAN: 'Biographical Memoir of A. A. Gould.' (Read by W. H. Dall.)

CHARLES S. HASTINGS: 'Biographical Memoir of James E. Keeler.'

CARL BARUS: 'The Diffusion of Vapor into Nucleated Air.'

H. P. BOWDITCH: 'Biographical Memoir of Theodore Lyman.'

ALEXANDER AGASSIZ: 'The Nomenclature of the Topography of the Bottom of the Oceans.'

S. Weir Mitchell: 'On the Discovery of an Antidote for Rattlesnake Poison.'

Alex. Graham Bell: 'On the Tetrahedral Principle in Kite Structure.'

BIOLOGICAL SOCIETY OF WASHINGTON.

The 370th meeting was held on Saturday, April 4.

H. J. Webber discussed 'Bud Sports and Bud Variation in Breeding.'

The speaker called attention to the very numerous cases of bud sports which have been described in literature and discussed a number of instances that had come under his personal observation. All parts of a plant, it was pointed out, may exhibit this phenomenon; in some cases almost the entire plant shows the change, while in others the variation is limited to a single fruit or flower or a segment of a fruit or portion of a flower.

Many cases seem unquestionably to be instances of reversion to some ancestral type, while in other cases the change would seem to be attributable to another cause. The writer outlined an hypothesis accounting for the occurrence of such bud sports as segregation changes in the division of meristematic cells in the bud. In plants of mixed or hybrid origin a segregation of the pangens or anlagen representing an allelomorph, or character pair, was presumed to occur in certain somatic cells resulting in a separation of the anlagen, as in the case of the pollen and egg cell formation of first generation hybrids, following Mendel's hypothesis. In the case of the appearance of new characters the speaker assumes that here, and also in the case of hybrids, the new combination of pangens representing various characters results in the formation of a new crystallization, as it were, which appears as a new character.

Rodney H. True described 'The Manufacture of Tea in America,' illustrating his remarks with lantern slides. He stated that all varieties of tea plant used in American experiments belonged to one botanical species, the class of tea, green, black or oolong, being in large measure the result of factory treatment.

There are present within the tea leaf tannin and oxidizing enzymes, which on uniting form a reddish-brown product, allied to the class of bodies known as phlobaphenes.

In the making of green tea the leaves are so dried as to destroy the oxidizing enzymes before they react with the tannin, thus retaining the green color of the leaf. The application of heat is the usual method of destroying the enzymes. Light exerts also a destructive influence on this class of bodies.

In making black tea any process hindering the reaction between the tannin and oxidases is avoided until the fermentation has been completed. The high temperature attained during the final firing destroys the oxidases and prevents further fermentation.

Oolong teas represent a class in which the action of the oxidases on the tannin has been begun, but has been stopped before full fermentation has taken place.

Owing to the fact that various varieties of tea contain oxidases in varying quantities, the readiness with which black tea can be made from these varieties is also variable.

W. C. Kendall spoke on 'The Trouts of the Rangeley Lakes,' saying that the fish fauna of these waters was poor in species, although the lakes were renowned for the size of their brook trout, examples of which reached a size of from nine to eleven pounds. The trout was now extinct in Lake Umbagog, and while the blame of this was laid on the pickerel, there were reasons for believing that the pickerel was not wholly, if at all, to blame. The speaker stated that while it had been denied that the Rangeley trout were decreasing, yet such was the case, and that the angler was probably to blame for it by the introduction of the landlocked salmon. This fish made additional demands on the small food supply, introduced a competitor to the trout and, possibly, an additional enemy. Mr. Kendall then discussed the blue-backed trout, *Salmo oquossa,* a species supposed to be peculiar to the Rangeley Lakes, and noted that this fish had become rare within the last few years, although those taken were much larger than the average size of this trout. The possible reasons for the decrease were considered, and

it was stated that possibly *Salmo oquossa, S. oquossa marstoni,* and *S. alpinus aureolus* might prove to be different forms of one species.

F. A. LUCAS.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

THE 176th regular meeting was held on March 12, 1903, fifteen members and three visitors present. Mr. W. D. Kearfott, of New York City, was elected a corresponding member, and Messrs. H. E. Burke and J. L. Webb, of the Bureau of Forestry, U. S. Department of Agriculture, active members.

Mr. Busck announced that a collecting excursion to Bladensburg had been planned for the 26th of March.

Mr. Ashmead exhibited two wasps from Trong, Lower Siam. The first, *Vespa doryloides* Saussure, superficially resembles the male of *Dorylus,* a genus of large ants. It appears to possess characters which differentiate it from *Vespa* and justify placing it in a new genus. The other specimen belongs to the genus *Ischnogaster.* This genus, though classified with the Eumenidæ, a family composed mostly of forms which are solitary in habit, is nevertheless said to be represented in India by social species. Mr. Ashmead showed, also, a specimen of the large Japanese wasp, *Vespa mandarinia* Smith, now placed in Thomson's genus *Vespula.*

Dr. Dyar presented a short paper entitled 'Note on *Crambus offectalis* Hulst and Allied Forms.' A specimen from New Mexico, confused with *offectalis,* is described as a new species of *Evetria.*

Mr. Barber read a letter written from Cuba by Mr. E. A. Schwarz, containing much interesting entomological matter. Dr. Howard stated that Mr. Schwarz had found what may prove to be the original food plant of the cotton-boll weevil (*Anthonomus grandis* Boheman), namely, the wild 'kidney cotton' (*Gossypium brasiliense?*)

Dr. Hopkins read extracts from letters reporting a recent very destructive outbreak of the 'pine bombyx' (*Dendrolimus pini* Linnæus) in the redwood forests in Norway. Until the past season the moth has not occurred there in sufficient numbers to cause serious damage since the outbreak of 1812 to 1816.

Dr. Dyar reported some early dates for the hatching of mosquito eggs. Eggs of *Culex canadensis* in his possession had hatched on the 9th of March, while at Lahaway, New Jersey, Mr. J. Turner Brakeley had found larvæ under the ice in February.

Mr. Banks showed a nest of the 'purse-web spider' (*Atypus abboti* Hentz) which he had found at Falls Church, Virginia. The species is rare here, though known as far north as Massachusetts.

Dr. Dyar presented a paper entitled 'New North American Lepidoptera, with Notes on Larvæ.'

Mr. Busck showed specimens of a buff and gold colored form of the codling moth (*Cydia pomonella* Linnæus), describing it as *simpsonii,* new variety.

Mr. Currie read a paper on 'The Odonata (dragonflies) Collected by Messrs. Schwarz and Barber in Arizona and New Mexico.' This collection, he stated, contained twenty-four species and two varieties. One species, an *Ischnura,* proved to be new.

Under the title 'Some Remarks on Japanese Hymenoptera' Mr. Ashmead commented upon the Japanese species in the U. S. National Museum. The Aculeata, he said, belonged mostly to described species, but in the Parasitica there were probably 150 new species. He believed there were in the neighborhood of 500 described Japanese Hymenoptera.

ROLLA P. CURRIE,
Recording Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 564th regular meeting was held February 28, 1903.

Mr. C. G. Abbot presented an elaborate approximate method for the quadrature of the circle, recently furnished by a correspondent of the Smithsonian Institution.

Mr. C. F. Marvin then spoke on 'The Seismograph.' He said the first instruments were crude and effective. The earthquake in Japan in 1880 led to the formation of a seismological society (among the first members of which were two of our own members,

Messrs. Mendenhall and Paul) and to the development of the modern type of instruments. A large instrument was exhibited of the 'inertia-type,' in which a heavy suspended mass serves as a fixed point for attachment of levers, the distant end of which carries a recording point, while a frame subject to any earth-tremors engages the levers at an intermediate point. Professor Newcomb described briefly the instruments shown him during the past summer at Göttingen.

Dr. A. L. Day then, with the aid of lantern illustrations, presented the modern view of 'Black Bodies' and the great developments that had followed the introduction of the hollow internally reflecting and radiating shell, whose radiations reached an outside instrument through a small hole in the wall. Such a body is theoretically more perfectly 'black' and practically more permanent and manageable than any body that is black to the eye. The methods of estimating the temperature of a highly heated body from the nature of its radiations were pointed out.

At the 565th meeting, held March 14, 1903, the death, on February 28, of Professor William Harkness, formerly the president of this society, was announced.

On the call for informal communications Professor Cleveland Abbe exhibited a collection of half-tone plates of snow-crystals just published by the Weather Bureau. The original photomicrographs were selected from the enormous collection of plates taken by Mr. Bentley, of Jericho, Vt.

The first regular paper had been announced to be by Mr. Gilbert T. Walker, of England, on 'Boomerangs'; but he was unable to appear, owing to a strain received in the afternoon during a public exhibition of his remarkable skill in designing and throwing these weapons. In his absence there was a general discussion of the subject and of his demonstrations. Attention was called to his papers on the subject in Science and the 'Smithsonian Report' for 1901.

The new Baldwin computing machine, made in the United States, and put on the market by the Spectator Company, of New York, was exhibited and explained by Professor Marvin. Speaking generally, it is similar in principle and capacity to the long-known Thomas machine, but is more compact and differs in nearly all its details.

Mr. George R. Stetson then read a paper on 'The Genetic Problem of Typography.' He outlined the various claims made for Coster, Fust, Guttenberg and Schoeffer, emphasizing the great difficulty of finding sufficient evidence to establish priority with certainty, and pointing out the very divergent conclusions to which the principal writers on this history have come. He concluded with a description of the Plantin Museum of Typography at Antwerp.

Charles K. Wead,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

January 19, 1903.—Mr. W. L. Sheldon presented a summary of the progress in the science of ethics, since the publication of Darwin's 'Descent of Man,' in 1871.

Two persons were elected to active membership.

February 2, 1903.—Dr. Tarleton H. Bean delivered an illustrated lecture on 'The Salmon and Salmon Fisheries of Alaska.'

Dr. R. J. Terry reported on a case of right aortic arch in man—of relatively rare occurrence—and by the aid of lantern slides and blackboard diagrams indicated its peculiar features and morphological significance with reference to the circulatory system of the embryo and of adults in lower groups of vertebrates.

One person was elected to active membership.

February 16, 1903.—Professor A. W. Greeley gave an account of experiments on protoplasm of variations in temperature and water contents, in which it was shown that in the case of certain algæ and protozoa, and in the eggs of some of the marine invertebrates, a reduction of temperature gave rise to parthenogenetic spore formation or egg segmentation, as was also the case when water was plasmolytically withdrawn from the cells.

One person was elected to active membership.

March 2, 1903.—Professor F. E. Nipher gave an account of his experiments in the production of ether waves by means of explosions. He is now using a brass tube, six feet long and one and one third inches in diameter, for the explosive, which is laid in a train from end to end. This tube is placed within a large brass tube, one and three eighths inches in diameter, which is wound with 25,700 windings of No. 25 copper wire. This coil is connected with a delicate D'Arsonval galvanometer. The coil is placed with its axis in the magnetic meridian. When gunpowder is exploded in the inner tube, the galvanometer gives indication of a change in permeability of the heated channel within the coil. The results were said to be as yet inconclusive, and the apparatus is to be somewhat modified, with a view to making it more sensitive.

March 16, 1903.—Dr. H. M. Whelpley gave an illustrated account of the sacred pipe-stone quarries of the upper Missouri.

April 6, 1903.—Professor A. S. Chessin presented a communication on the strains and stresses in a rotating thin circular disk.

Professor F. E. Nipher reported that he had apparently succeeded in producing a distortion of a magnetic field by means of explosions. The apparatus used was a transformer consisting of concentric coils wound upon brass tubes. The outer tube was five inches in diameter and six feet long, wound with over four thousand windings of No. 16 wire. This coil was traversed by a continuous current from a storage battery. Within this, and separated from it by an air-space of an inch, is a secondary coil of equal length having over twenty-five thousand windings of No. 25 wire. This coil is connected to a D'Arsonval galvanometer. Within the tube on which this coil is wound is a smaller brass tube, within which a train of black gunpowder is laid. This tube is open at both ends, and has practically no recoil when the explosion is made. When hung by a bifilar suspension on cords ten feet in length, the recoil is about an inch. When the exciting current is small compared with the capacity of the battery, the galvanometer reading is very steady. When the train is exploded, a sudden and marked throw of the galvanometer results, which could be accounted for by an increase in the permeability of the long explosion chamber. The deflection reverses when the field in reversed. The hot gases liberated in the explosion are all diamagnetic, and tend to decrease the observed effect. In two cases the galvanometer deflection was in the opposite direction from that stated above, and this is being further inquired into. When seven tubes between the two coils are simultaneously exploded, only slight effects could be obtained, and these deflections are wavering, or to and fro, in character. A wire was threaded through the inner combustion tube, through which a current of three ampères was passed. This circuit was opened and closed with no visible effect. The galvanometer circuit is shielded by tin-foil, which is also connected with the explosion tube, and grounded. Sparks an inch long to the tin-foil produce no result. When the explosion tube is removed from the transformer, and taken near the galvanometer, or the storage battery, no deflection is produced by the explosion.

An explosive mixture of gases from water electrolysis under atmospheric pressure produces a much less violent explosion, and produces a correspondingly less effect. The scale reading of the galvanometer changes by over twenty divisions with the heaviest explosions and an exciting current of 0.6 ampère. With smaller explosions or feebler currents, the effect is diminished. No deflections can be produced by striking the table upon which the transformer rests, nor by striking the transformer itself, even when it moves slightly under the blow. The secondary and primary coils are held rigidly in fixed position with respect to each other.

Arrangements have now been made to place the explosion tube in the focal line of a parabolic cylinder of metal, the galvanometer coil being in the focal line of a similar mirror. Either or both are to be surrounded by an exciting coil.

This line of research was suggested by Young's account of his observation of five

solar outbursts in 1872, which were each accompanied by sharp fluctuations in the magnetic tracings at Kew and Stonyhurst. Since the experiments began, volcanic explosions have produced such ether waves, which have been simultaneously recorded over the continents of Europe and America.

Mrs. Eliza McMillan and Mr. Wm. Northrop McMillan, the donors to the academy of a home, as noted elsewhere, were elected patrons of the academy.

William Trelease,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

THE FIRST USE OF THE WORD 'BAROMETER.'

To the Editor of Science: I quite agree with Dr. Bolton's conclusion that Robert Boyle introduced the word 'barometer' into our language about the year 1665 (Science, p. 548). Although Dr. Bolton finds that the first use of the word by Boyle was in the *Philosophical Transactions* of 1666, yet he suspects him to be the author of an anonymous communication to that journal the previous year, in which the 'suspended Cylinder of Quicksilver' was called a 'Barometer or Baroscope.' For conclusive proof that Boyle really used these terms in the year 1665, I would cite a work that appears to have escaped Dr. Bolton's notice, viz., 'The General History of the Air * * * by the Hon. Robert Boyle, Esq.,' published in London in 1692, which contains 'A short Account of the Statical Baroscope, imparted by Mr. Boyle, March 24, 1665.' In this letter to Mr. H. Oldenburgh, Boyle describes the instrument as some large and light glass bubbles, counterpoised in a pair of scales, and placed near a 'Mercurial Baroscope' (also called a 'Barometer' in the same letter), from which he might learn the present weight of the atmosphere. The same work contains probably the earliest systematic register of thermometer, barometer, hygrometer, wind and weather in England, viz., that kept by J. Locke, the philosopher, at Oxford and at London, between 1666 and 1683, with interruptions. The reading of the mercurial barometer, designated at first 'baroscope,' was recorded in inches and tenths, but in another register, kept at Townley, in Lancashire, during a portion of the years 1670 and 1671, it was recorded to hundredths of an inch.

Professor G. Hellmann, the eminent German meteorological bibliographer and historian, although cognizant of Boyle's 'General History of the Air,' seems to be unaware of the letter quoted, since he also states in the introduction to No. 7 of his 'Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus' that the word 'barometer' was first used by Robert Boyle in 1666, whereas it is certain, from what I have shown, that Boyle had already employed it the year before.

A. Lawrence Rotch.

Blue Hill Observatory,
April 13, 1903.

SHORTER ARTICLES.

A PRELIMINARY ACCOUNT OF THE EXPLORATION OF THE POTTER CREEK CAVE, SHASTA COUNTY, CALIFORNIA.

The Potter Creek cave lies in a belt of gray Carboniferous limestone, about a mile southeast of the United States Fishery Station on the McCloud River at Baird, Shasta County. The mouth of the cave is situated in a bluff on the north side of Potter Creek, at an elevation of 1,500 feet above sea level, and about 725 feet above the McCloud.

The existence of bones in the cave was first discovered in 1878 by Mr. J. A. Richardson, who found there the skull of a large extinct bear afterwards described by Professor Cope as *Arctotherium simum*.* This specimen is now in the Cope collection at the American Museum of Natural History, New York.

The cave was rediscovered by Mr. E. L. Furlong, of the University of California, in July of the past year. Mr. Furlong penetrated the deposit on the floor of the main chamber, with the result that a large number of bones representing a Quaternary fauna were found in a series of stratified deposits of pebbly clay, cave breccia, stalagmite and volcanic ash. On Mr. Furlong's return to

* Cope, *Am. Nat.*, XIII., p. 791; XXV., pp. 997–999, Pl. XXI.

Berkeley the exploration was continued by the writer.

The work of excavation has been generously supported by Mrs. Phoebe A. Hearst as a part of the investigation being carried on with a view to determining the antiquity of man in California, and has been conducted under the direction of Professor J. C. Merriam. Through the kindness of Dr. W. C. Bruson and Mr. D. P. Doak, the controllers of the property, a lease has been secured, and the deeper portion of the cave will be explored during the coming summer.

The system of galleries which comprises the Potter Creek cave extends in a northwest-southeast direction, in a general way parallel with the strike of the limestone. The floor of the principal chamber is 42 feet beneath the opening communicating with the winding passage leading to the exterior. It can be reached only by a vertical rope ladder secured above to a convenient stalagmite pillar. This chamber has a length of 106 feet and is 29 feet wide at its widest part. It narrows to a width of four feet at the extreme northwest end. Both walls slope toward the west, the west wall overhanging. The vaulted roof rises at least sixty feet above the floor. Numerous massive pendants ornament the hanging wall.

The floor of the large chamber was of pebbly clay and cave breccia. The main deposit was in the form of an alluvial fan with its apex in the narrow northwest end. The surface of the fan was in general convex, flattening somewhat toward the center of the chamber. A thin superficial layer of stalagmite was present on the margin of this deposit adjoining the west wall. In the southeast end there is also a fan, rising almost as high as the one just described. The surface of this slope down almost to the lower edge is covered with a firmly compacted cave breccia and is strewn with large fallen blocks of limestone and broken stalactites.

Work was begun in the clay about the middle of the main chamber, near the margin of the northwest fan, and was carried toward the northwest end. The surface of the deposit was staked out in four-foot squares, and each of these sections was worked in ten-inch levels, all the specimens from each level being labeled with the number of the section and the depth at which they were found.

The structure of this fan was as follows, in descending order:

A. Pebbly clay with gravel lenses, 4 to 13½ feet.

B. Persistent gravel stratum, 6 inches to 1½ feet.

C. Volcanic ash, up to 1½ feet.

D. Clay with fallen limestone blocks, up to 3 feet.

E. Stalagmite cementing angular blocks of limestone (false floor), 18 inches or more.

The pebbly clay (stratum A), is a reddish clay similar to that produced by the subaerial decay of the limestone and intrusive diabase. It contains abundant angular fragments of blue limestone and occasional pieces of stalactite from the roof. This deposit varies in thickness from four feet to thirteen and a half feet. A layer of stalagmite partly capping this reddish earth on the west margin rarely exceeds a few inches in thickness, usually averaging from half an inch to an inch. It is closely associated with the pendants fringing the west wall, and has been largely deposited by water dripping from them.

Beneath the capping stratum of clay, two main gravel lenses are distinguishable. These roughly parallel the surface of the fan and feather out toward the northwest margin. The gravel strata, so called, are composed of angular, drip-washed limestone fragments, and could readily be formed by water falling from the roof and washing the small limestone fragments out of the clay. These strata vary from three or four inches to a foot and a half in thickness. On approaching the west wall, the gravel lenses were in some cases found to coincide with sheets of stalagmite. The gravel strata are separated by beds of clay, similar in every respect to the first clay stratum described. On the disappearance of the gravel all these clay strata blend.

Beneath the persistent gravel layer (stratum B) is a deposit of fine particles of volcanic glass (stratum C), which appear to have drifted into the cave by wind action in Qua-

ternary time and to have been deposited in a small body of standing water. The prevailing color of the ash is an ocherous yellow, but some samples have a brownish tint. The deposit varies from a fraction of an inch to a foot and a half in thickness, thinning out toward the northwest and southeast margins. At the former margin it is seen to dip about five degrees toward the southeast. Throughout it is well stratified and shows little mixture with foreign material. Chemical analysis shows the glass to contain 63.69 per cent. of silica. This indicates that the ash is either andesitic or trachytic, with the probability in favor of the former. Its source has not been determined. It was probably derived from some of the volcanoes of the Cascades, perhaps from Lassen Peak or Shasta.

Stratum D, beneath the volcanic ash, is a clay layer varying from a small fraction of an inch to three feet in thickness. It commonly contains angular boulders of limestone and large pieces of stalactite. More or less stalagmitic cementation is locally present.

Excavation ceased temporarily at the surface of a hard sheet of breccia (stratum E), which lay beneath the last-mentioned clay. This breccia sheet was penetrated at one point, where it was found to be eighteen inches thick.

During the excavation there was discovered a circular series of chambers not before visible. The opening leading to these chambers was in the west wall of the main cave and was buried beneath about eleven feet of stratified deposits. The northwest gallery of this new series contains a stream of earth derived from that in the main cave. The top of this fan, at the entrance, is level with the top of the hard breccia floor (stratum E). It slopes steeply to the west and has the greater part of its surface covered with white crystalline stalagmite. Near the entrance the stalagmite contains imbedded bones. Bones were also scattered at irregular intervals down the slope.

The materials forming the various deposits above the hard breccia floor (stratum E) have been derived largely from external sources. The stratigraphy of the fan excavated shows that the greater part of its material entered the cave from the outside through a narrow fissure in the limestone, which can still be seen, choked with earth, forty feet above the apex of the fan. From this fissure, earth and bones fell through a chute-like opening to the floor below. The earth in the westerly lying series of galleries has entered from this same source, sliding to the west as the bottom of the main chamber filled. All the bones in the west galleries are older than those occurring above the stratum of volcanic dust in the main room. The volcanic material, in undisturbed position, lay about two feet above the entrance to these galleries. The fan in the southwest end has also been derived largely from external sources, entering through an opening similar to that already described. In addition to these openings and the existing entrance to the cave, there have probably been others which are more or less completely closed by the formation of calcite growths.

Although the cave seems to have been formed along a fissure by percolating water removing the limestone in solution, so far as explored, nothing approaching a residual cave earth has been found in place in the lower chambers. There is no evidence to prove that the cave has been excavated by stream action. A few stream-worn pebbles have been found in the lenses of drip-washed limestone fragments, but, like the majority of the bones, these pebbles have fallen into the cave from without, and have not been rounded by water action in the cave.

Bones were found in all the strata explored excepting the volcanic ash. In all cases they have lost their organic matter completely. In the superficial layers of the clay stratum they are commonly blackened, but at deeper levels they are white and quite brittle. In the gravel lenses scattered teeth and small bones of various rodents are particularly abundant. A large percentage of the material collected consists of fractured bones which it is usually impossible to identify. The edges of the fractures are quite sharp, except where they have been gnawed by rodents before entombment. Apart from these fragments, over four

thousand determinable specimens in an admirable state of preservation were collected. This material requires no preparation, excepting to wash off the adhering clay. Few of the large bones are broken and none are crushed or distorted by pressure. The majority of the specimens collected are dissociated limb bones, jaws and teeth. Few complete skulls were found. Connected skeletons of single individuals are exceedingly rare. Associated parts of the skeletons of several squirrels and of the large bear *Arctotherium simum* were the only ones found. Remains of the latter were particularly abundant along the east wall, some of the best material occurring in loose earth at depths of from four to six feet. At this place complete limbs with all the elements in their natural position were found. The fact of the association and better state of preservation of the remains of *Arctotherium* suggested to Mr. Furlong that these animals lived in some part of the existing cave, or possibly in some gallery which has been destroyed by subsequent erosion. If these animals really lived in the cave, many of the angular fragments of bone already referred to may be the relics of bears' feasts. Associated with the bones are shells of a land mollusc referable to the genus *Epiphragmophora,* and of a fresh-water form allied to *Margaritana falcata* living in the McCloud River.

Traces of man's existence have been diligently sought, and a number of polished and pointed bones have been found which might serve as rude implements. So much depends on the determination of these as artifacts that it is deemed best to reserve judgment and await fuller exploration.

The following is a provisional list of species identified. Professor Merriam and the writer are much indebted to Dr. C. Hart Merriam for valuable assistance in determining the rodents and carnivores:

Arctotherium simum Cope.
Ursus sp. nov. Merriam, J. C.
Felis sp. nov. Merriam, J. C.
Felis near *hippolestes* Merriam, C. H.
Lynx fasciatus Rafinesque.
Lynx fasciatus subsp. nov. (?).
Urocyon townsendi Merriam, C. H.
Vulpes cascadensis Merriam, C. H.
Lupus sp. nov. Merriam, J. C.
Taxidea (?) sp. nov. Merriam, J. C.
Bassariscus raptor Baird.
Mephitis occidentalis Baird.
Spilogale sp. nov. Merriam, J. C.
Putorius arizonensis Mearns.
Sciurus hudsonicus albolimbatus Allen.
Spermophilus douglasi Richardson.
Lepus californicus Gray.
Lepus sp. nov.
Lepus klamathensis Merriam, C. H.
Lepus near *audoboni* Baird.
Teonoma sp. nov.
Neotoma fuscipes Baird.
Arvicola sp.
Thomomys sp. nov.
Thomomys near *leucodon* Merriam, C. H.
Aplodontia either a new species or a new subspecies of *A. major.*
Scalops cf. *townsendi* Bachman.
Odocoileus columbianus Richardson.
Odocoileus sp.
Camelops (?) sp.
Megaloynx sp.
Mastodon americanus Kerr.
Elephas primigenius Blumb.
Tapirus sp.
Equus occidentalis Leidy.

In addition to the species listed, there are a large number of birds which have not yet been studied, a snake, a tortoise, a bat and one or more fishes.

Associated with species characterizing open country, the list shows a considerable proportion of mountain and forest types. Seventeen of the thirty-five species and subspecies listed are extinct. So far as known there is no difference between the species from the various strata, although the remains of *Arctotherium* are perhaps more numerous in the deeper layers. No Pliocene forms have been found, although such may occur at deeper levels in the unexplored portions of the cave.

The accumulation of the portion of the cave deposit which has been studied took place during middle or later Quaternary time. Nevertheless, the cave fauna indicates that great changes in the topography of the region have taken place. The present mountainous character of the country, and especially the

ruggedness of the limestone belt in which the cave lies, are entirely out of harmony with the existence of mastodons, elephants and tapirs. Stream-worn pebbles occur in the cañon of the McCloud, at Baird, as high as 750 feet above the river. The deposit in the cave dates from a time when the river flowed at a higher elevation than it does now, but not at the 750-foot point, otherwise the cave would have been flooded, and of this there is no evidence. At this time the cave was, in part at least, an open fissure receiving material washed in during the wet season.

There are three well-defined terraces in the cañon of the McCloud. The lowest of these is about 25 feet above the mean low-water level of the river. A second terrace occurs about 30 feet higher. The best-developed terrace is about 75 feet above the stream. The cave deposit was probably formed before these terraces were cut, since a comparatively short time has been required for the river to cut down to its present level from the level of the upper terrace. This terrace is rock cut with a thin veneer of gravel on its surface. When the river flowed at the level of this terrace, it is not believed that the region was topographically adapted to the existence of tapirs and the large proboscideans, except perhaps along the stream.

A full report embodying the results of further work on the cave and descriptions of new species will appear later, in the Publications of the University of California.

Wm. J. Sinclair.
University of California,
Berkeley, California.

CURRENT NOTES ON METEOROLOGY.

HELM CLOUD IN THE BLUE RIDGE OF NORTH CAROLINA.

When wind is forced to cross a mountain ridge, standing waves may be produced in the air currents to leeward of the ridge. If the involuntary ascent of the air is sufficient to bring about condensation, clouds are formed in the ascending portion of these waves. The best known of these clouds is that called the *Helm Bar*, which is frequently observed when a damp easterly wind blows over the Cross Fell range, in northwestern England. Attentive observation in mountainous districts ought to bring record of the occurrence of many such clouds in different parts of the world. W. M. Davis (*Bull. Geogr. Soc. Phila.*, III., No. 5, 1903) calls attention to a similar cloud which he observed during a recent field trip to the Blue Ridge in North Carolina. On a morning with a clearing northwest wind, while standing on Mt. Mitchell, he noted that a rolling helm cloud was formed above the Blue Ridge escarpment. The cloud held its place, continually forming and dissolving, for more than an hour, while many detached fragments of the cloud floated away and disappeared during this time. This is the first mention of the occurrence of helm clouds in this section.

METEOROLOGICAL PHENOMENA OF VOLCANIC ERUPTIONS.

An ascent during an eruption of the volcano Puracé, near the city of Popayan, the capital of the Department of Cauca, in the Republic of Colombia, is described by R. B. White in the *Scottish Geographical Magazine* for February. The eruption occurred in October, 1869, and Mr. White was requested by the natives to ascend the mountain during the eruption, in order that he might report to them regarding the danger that threatened the neighborhood. A number of interesting phenomena were noted, one of which was the sudden tremendous flood which came down the river Cauca, produced by the almost instantaneous melting of 'at least 8,000,000 cubic feet of snow that lay on the mountain.' The column of steam reached a height of three miles, having the appearance of immense cumulus clouds, and spreading out at the top like the crown of a great tree. (Similar mushroom-shaped clouds were noted, and photographed, during the Mont Pelée eruptions of last summer). During the night frequent torrents of mud and rocks rushed down the mountain sides. These, Mr. White believes, came from the melting of the heavy snow which had resulted from the condensation of the great volumes of vapor thrown up from the crater. This snow melted rapidly on the

heated cone, and the water rushed down hill, gathering loose earth and rocks as it went.

JAMES GLAISHER.

JAMES GLAISHER, who died on February 7, last, although he contributed in many ways to the advancement of meteorology, will always be remembered chiefly for his famous balloon ascent on September 5, 1862, with Coxwell, when these two intrepid aeronauts reached a height of about 37,000 feet above sea level, and established a record for high ascents. With the recent rapid development of balloon meteorology, attention has naturally very frequently been directed to this famous balloon voyage, and Glaisher's account of it, published in his 'Travels in the Air,' has doubtless been more generally read within a few years than it was when the book first appeared. Glaisher made many scientific balloon ascents during the early '60's, the results of which were communicated to the British Association, and for more than fifty years he contributed reports on the meteorology of England to the periodical returns of the Registrar-General of Births, Deaths and Marriages for England and Wales. He also published some hygrometrical and temperature tables; a report on the meteorology of India, and another on the meteorology of Palestine, and was one of the founders of the Royal Meteorological Society.

ATLAS OF THE ATLANTIC OCEAN.

THERE has recently been published a second edition of the valuable 'Atlas of the Atlantic Ocean,' issued by the Deutsche Seewarte in Hamburg. This atlas, with the accompanying 'Segelhandbuch,' embodies the latest and most complete information concerning the meteorology of this ocean. Atlases and sailing directions have also been published for the Indian and Pacific Oceans. Of the charts in these atlases perhaps the most striking are those showing the generalized winds. These charts bring out, in the most emphatic manner, the great wind and calm belts of the doldrums, trades, horse latitudes and prevailing westerlies. It is a pity that no enlargements of these admirable charts of winds are available for school use.

NOTES.

IT is very significant of the advance that has been made within a few years in balloon and kite meteorology, that the results of the meteorological observations made in the free air during ascents from the Prussian aeronautical observatory have, since last November, been published daily in three Berlin newspapers. R. DEC. WARD.

GEOGRAPHY IN THE UNIVERSITY OF CHICAGO.

THE University of Chicago has established a department of geography, and Professor Rollin D. Salisbury, of the department of geology, has been placed at its head. The arrangement between the departments of geology and geography is such that Professor Salisbury retains his connection with the former, as heretofore, at the same time that he assumes the headship of the latter. The close connection of the two departments appears from the fact that Professor Salisbury will also act as head of the department of geology when Professor Chamberlain is not in residence, and Professor Chamberlin will act as head of the department of geography in Professor Salisbury's absence.

The department of geology has heretofore offered courses, both elementary and advanced, in physical geography, and elementary courses in meteorology. Other courses of a geographic character have been offered by other departments, notably geographic botany by the department of botany, zoogeography by the department of zoology, and commercial geography by the department of political economy. These courses will continue to be given, as heretofore, by these several departments, except that meteorology will be under the auspices of the new department. The new department will not duplicate the geographic courses already given, but will, at the outset, provide courses which supplement those already established. The immediate aim of the new department will be to occupy the ground intermediate between geology and

climatology on the one hand, and history, sociology, political economy and biology on the other. The courses offered at the outset will be those for which, within his field, there is greatest demand.

John Paul Goode, Ph.D., in charge of the work of geography in the Wharton School in the University of Pennsylvania, has accepted an assistant professorship in the department of geography, and will begin his work the second term of the summer quarter (July 27, 1903). No other appointment will be made this year. During his first year, Dr. Goode will be in residence during the second term of the summer quarter, and during the autumn and spring quarters. The courses which he will give during the first year will include courses on the economic geography of (1) North America, (2) Europe and (3) tropical countries. The central theme of these courses will be the influence of the physiography, the climate and the natural resources of these lands on their settlement, development and present commercial and industrial status. Research courses will also be offered for advanced students.

The geographic work of the university during the coming year will include the following courses, in addition to those given in the department of geography:

I. In the *Department of Geology*—(1) An elementary course in physiography, each quarter; (2) A local field and laboratory course, first term, summer quarter; (3) two field courses in geology and geography about Devil's Lake and the Dells of the Wisconsin, in Wisconsin, one month each, commencing June 18 and July 27, respectively; (4) a course in advanced physiography, autumn quarter; (5) a field course (for advanced students) in the Wasatch Mountains of Utah and vicinity.

Other courses which, while primarily geological, are fundamental to the proper conception of the evolution of the present geography of the continents, will also be given in this department.

II. In the *Department of Zoology*—Courses in zoogeography, summer and spring quarters.

III. In the *Department of Botany*—(1) An elementary course in plant geography (time not announced); (2) an elementary course in ecology, summer and spring quarters; (3) elementary and advanced courses in field botany, summer and spring quarters; (4) advanced courses in geographic botany, winter quarter; and (5) a course in physiographic ecology, summer and spring quarters.

IV. In the *Department of Political Economy*—Courses in commercial geography, summer, autumn and winter quarters.

V. In the *Departments of History and Sociology*. Certain courses in these departments have a distinctly geographic bearing.

School of Education.—In addition to the foregoing, courses in geography will be given by Miss Baber in the School of Education (the normal department of the university). These courses are planned primarily with reference to the needs of teachers in the grades. Miss Baber will also conduct a field course of one month's duration during the second term of the summer quarter, beginning July 27.

A BIOLOGICAL STATION AT BERMUDA.

Harvard University and New York University unite with the Bermuda Natural History Society in inviting botanists and zoologists to spend six weeks in the temporary biological station provided for the present season at Bermuda.

By special arrangements with the Quebec S. S. Co. and the Hotel Frascati it has been possible to make the total expense, including transportation from New York and return, and board and lodging for six weeks at Bermuda, one hundred dollars.

The Bermuda Natural History Society has expressed its intention to do everything in its power to make the summer's work as profitable and pleasurable as possible, and to this end has undertaken to provide, among other things, the necessary facilities for collecting, namely, a steam launch, thirty to forty feet long with crew; a sail boat with fish-well and crew; three rowing boats, and a carriage with two horses capable of carrying ten or twelve persons. The laboratory will be equipped with all necessary reagents and utensils except microscopes and dissecting instruments, which should be brought by each investigator.

There are two possible dates of sailing from New York; June 20 and July 4. The laboratory will be opened for those who sail on June 20 and will remain open eight weeks, thus providing for those who can not sail until July 4.

The well-known richness of the sub-tropical fauna and flora, the healthfulness and equable temperature of the islands, and the ease with which they may be reached combine to make the Bermudas a most attractive field for biological research.

Venerable George Tucker, archdeacon, president, Bermuda Natural History Society.

Hon. W. Maxwell Green, Consul U. S. A., vice-president, Bermuda Natural History Society.

F. Goodwin Gosling, honorary secretary, Bermuda Natural History Society.

E. L. Mark, director Zoological Laboratory, Harvard University.

C. L. Bristol, professor of biology, New York University.

Circulars and detailed information will be supplied on application either to Professor C. L. Bristol, University Heights, New York City, or to Professor E. L. Mark, 109 Irving St., Cambridge, Mass.

PROGRESS TOWARD AN INTERNATIONAL COMMISSION OF ARCHEOLOGY AND ETHNOLOGY.

DURING the Second International Conference held in Mexico in the winter of 1901–1902, a proposal that the creation of an International Archeologic Commission be recommended to the participating countries received much attention; and on January 29, 1902, a formal recommendation to that effect was adopted. It is printed *in extenso,* in Spanish, English and French, on pages 141–147, in the report of 'Recomendaciones, Resoluciones, Convenciones y Tratados,' published officially soon after the adjournment of the conference.

Action was taken on the recommendation within a few months by the Republic of Mexico, President Diaz appointing Señor Don Alfredo Chavero (a distinguished archeologist, soon afterwards made director of the Museo Nacional) to inquire into the feasibility of establishing such a commission, and to confer with representatives of other countries. Dr. Chavero visited the United States in the autumn of 1902, and conferred with the diplomatic representatives of the various American countries in Washington, as well as with the archeologists and ethnologists in attendance at the International Congress of Americanists held in New York in October. On returning to Mexico he reported progress, pursuant to which President Diaz delegated His Excellency, Señor Don Manuel de Aspiroz, the Ambassador from Mexico to the United States, as a representative of the commission empowered to treat with similar delegates from other countries.

The recommendation of the International Conference came to the notice of several scientific societies in this country; and on July 1, 1902, the American Association for the Advancement of Science and the American Anthropological Association adopted resolutions approving the contemplated action.

In November, 1902, the Secretary of State designated Dr. W J McGee, ethnologist in charge, Bureau of American Ethnology, as a representative on the part of the United States to confer with similar representatives on the part of other countries in arranging for the organization of the commission; being in the City of Mexico soon afterwards, he conferred with President Diaz, Dr. Chavero and others, and after his return continued the conferences with the Mexican Ambassador as well as with Honorable W. W. Rockhill, director of the Bureau of American Republics. In these conferences a plan for the organization of the commission was framed.

On April 15, 1903, a meeting of representatives of several American countries, convoked by the Secretary of State at the instance of the Ambassador for Mexico, was held in the State Department. The draft of plan for organization of the commission was submitted by His Excellency, Señor de Aspiroz, and some of its features were explained by Dr. McGee. After full discussion the plan was approved without dissenting voice; the representatives of four countries signified the intention of adopting it on behalf of their governments, while other ministers explained the necessity of withholding final action pending instructions from their respective governments, and it was

unanimously voted to recommend the adoption of the plan and the making of a moderate appropriation for carrying out its purposes to the several American countries. It was also decided by a unanimous vote to assemble in session for final organization on the third Monday in December, 1903, and meantime to invite the several American governments to designate commissioners to attend this session and participate in the organization.

Under the plan adopted the commission is designed to form an administrative corps and include a scientific corps, the former to be made up of commissioners officially designated by the participating governments, to a number not exceeding three from each, and to have a president, two vice-presidents, and a secretary, to be elected for terms of four years; the commissionerships and these administrative offices to be honorary. The scientific corps is designed to include trained scientists and scientific attachés, to be chosen by the commission, with a director-general and a secretary, and a director for each participating country; these positions to be either honorary or salaried, and commissioners being eligible. The specified objects of the commission are (1) to promote the unification of laws relating to antiquities in the Western Hemisphere; (2) to increase and diffuse knowledge concerning these antiquities and the aboriginal peoples by whom they were produced; (3) to awaken interest in the vestiges of a vanishing race; (4) to unify museum methods throughout the American countries; and (5) to work for the establishment of one or more archeologic and ethnologic museums of international character. Provision is made for the acquisition, preservation and transfer of museum and office property, for the exchange of collections and scientific workers among the several countries, for annual and special sessions of the commission and the scientific corps, and for the preparation and publication of reports. The recommendations of the International Conference extended to the custody and preservation of aboriginal structures, and it is planned to take up this duty as the work of the commission proceeds.

SCIENTIFIC NOTES AND NEWS.

At the stated session of the National Academy of Sciences on April 21, 22 and 23, new members were elected as follows: T. C. Chamberlin, professor of geology, University of Chicago; William James, professor of philosophy, Harvard University; E. L. Mark, professor of anatomy, Harvard University; Arthur G. Webster, professor of physics, Clark University; Horace L. Wells, professor of analytical chemistry and metallurgy, Yale University. President Ira Remsen, of the Johns Hopkins University, was elected vice-president, and Professor Simon Newcomb, foreign secretary. Professor George E. Hale, director of the Yerkes Observatory, was awarded the Draper medal and made a member of the council. Foreign associates were elected as follows: W. C. Brogger, professor of mineralogy and geology, University of Christiana; Robert Koch, professor of hygiene, University of Berlin; E. Ray Lankester, director of the British Museum of Natural History; D. J. Mendeleef, professor of chemistry, St. Petersburg; Wilhelm Pfeffer, professor of botany, University of Leipzig; M. Picard, professor of mathematics, University of Paris; J. J. Thomson, Cavendish professor of physics, Cambridge University; H. K. Vogel, director of the astrophysical observatory near Potsdam; and Ferdinand Zirkel, professor of mineralogy, University of Leipzig.

Professor Simon Newcomb, of Washington, has been appointed a delegate from the National Academy of Sciences to the International Association of Academies, which meets in London this coming June. Mr. S. F. Emmons and Mr. Geo. F. Becker, of Washington, and Professor C. R. Van Hise, of Madison, Wis., have been appointed delegates to the International Geological Congress, which meets in Vienna in August of this year.

At the request of the Secretary of State, the president of the National Academy of Sciences has appointed a committee to consider what means, if any, should be taken to preserve the original copy of the Declaration of Independence. The signatures of the signers

are now nearly obliterated, and the parchment shows evidence of decay. The committee appointed consists of Dr. Chandler, of Columbia University; President Remsen, of Johns Hopkins University, and Dr. Billings, Librarian of the New York Public Library.

AT the meeting of the American Academy of Arts and Sciences held April 8, 1903, in the Harvard University Museum, the Rumford premium, consisting of a gold and a silver medal, was presented to Professor George E. Hale, director of Yerkes Observatory, in recognition of his researches in solar and stellar physics and in particular for the invention and perfection of the spectro-heliograph. The grounds of the award of the premium were explained to the academy by the chairman of the Rumford committee, Professor Charles R. Cross; the medals were presented by the president of the academy, Dr. Alexander Agassiz, and Professor Hale in connection with his acknowledgment of the honor conferred upon him described his work and exhibited a number of lantern slides in illustration.

THE University of Edinburgh has conferred the degree of LL.D. on Dr. Arthur Gamgee, F.R.S., emeritus professor of physiology at Owens College, Manchester, and on B. N. Peach, F.R.S., of the Geological Survey Office, Edinburgh.

DR. A. HRDLICKA has been appointed assistant curator of the Division of Physical Anthropology at the U. S. National Museum.

MR. HENRY E. WILLIAMS has been appointed assistant chief of the U. S. Weather Bureau. This position was created by the last agricultural appropriation act.

SIR ARCHIBALD GEIKIE, F.R.S., has been elected an honorary member of the British Institution of Civil Engineers.

DR. SIMON FLEXNER, professor of pathology at the University of Pennsylvania, director-elect of the Rockefeller Institute for Medical Research, was given a dinner at the University Club, Philadelphia, on April 16, Dr. S. Weir Mitchell presiding.

THE Association for maintaining the American Woman's Table at the Zoological Station at Naples and for promoting Scientific Research by Women has awarded its prize of $1,000, offered two years ago, for the best scientific research done by a woman, to Dr. Florence R. Sabin, assistant in anatomy at the Johns Hopkins University Medical School. She presented a research on the 'Origin of the Lymphatic System.' Honorable mention was given to a paper entitled 'Contributions to the Life History of Pinus,' by Miss Margaret Clay Ferguson, instructor in botany at Wellesley College. The prize will again be awarded in 1905. Miss Grace E. Cooley, associate professor of botany at Wellesley College, has been awarded the table at the Naples Station.

The British Medical Journal states that the executive committee of the Carnegie Institution, Washington, has made a grant of $5,000 and traveling expenses to Professor Arthur Gamgee, emeritus professor of physiology, Owens College, Manchester, to enable him to prepare a report on the physiology of nutrition. The object in view is to secure information which may lead to the organization in the laboratories of various countries of cooperative research in the problems of human nutrition.

DR. ALBERT P. MATTHEWS, assistant professor of physiological chemistry at the University of Chicago, lectured before the Yale Alumni Association on April 22, his subject being 'The Action of Inorganic Salts on Protoplasmic Activities.'

DR. DUNCAN S. JOHNSON and Mr. Forrest Shreve, of Johns Hopkins University, have gone to Jamaica for special work in botany. They will join Professor L. M. Underwood, of Columbia University.

THE party from the Lick Observatory of the University of California, which is to establish a temporary observatory in Chili, has arrived at Santiago.

MR. THOMAS H. MEANS, of the Bureau of Soils, Department of Agriculture, has returned from an investigation on the methods of reclaiming alkali lands in Egypt, the re-

sults of which will be shortly published in a bulletin.

Dr. Jean Charcot, of Paris, has decided to go to the Antarctic instead of the Arctic regions. He will go first to Terra del Fuego and thence to Alexander Island, whence he will endeavor to penetrate as far as possible into the South Polar continent.

Articles of incorporation of the John Fritz Metal Fund Corporation have been filed at Albany. It will be remembered that the medal is to be conferred under the auspices of our four great engineering societies. The directors of the corporation are J. J. R. Croes, Alfred Noble, C. W. Hunt, E. E. Olcott, E. G. Spilsbury, James Douglass, C. Kirchoff, New York City; Robert Moore, of St. Louis; Gaetano Lanza, of Boston; John E. Sweet, of Syracuse; Robert W. Hunt, of Chicago; S. T. Wellman, of Cleveland; Arthur E. Kennelly, of Cambridge, Mass.; Carl Hering, of Philadelphia; Charles P. Steinmetz, of Schenectady, and Charles F. Scott, of Pittsburgh.

Dr. Josiah Willard Gibbs, since 1871 professor of mathematical physics at Yale University, died on April 28.

Dr. Moritz Lazarus, honorary professor of psychology at the University of Berlin, died on April 13, at the age of seventy-nine years.

Mr. Andrew Carnegie, before leaving for Scotland on April 24, offered to give $1,500,000 for the erection of a court house and library for the permanent court of arbitration established at The Hague by the treaty of July 29, 1899. Mr. Carnegie also gave last week five per cent. U. S. Steel Company first mortgage bonds, the par value of which is $600,000 and the market value about $500,000, to the endowment fund of the Tuskegee Normal and Industrial Institute.

A Reuter telegram from Wiesbaden reports that the International Conference on Deep-sea Investigation was opened there on April 17, under the presidency of the Prince of Monaco, those present including professors of geography and other geographical experts from England, Germany, France, Norway and Sweden. The committee appointed by the Geographical Congress which met in 1899 presented a report on questions connected with oceanic research at great depths. The conference was engaged in the preparation of charts of the ocean beds to be sent to the next International Geographical Congress, which is to meet at Washington in 1904.

Nature states that the biennial Hunterian Oration was delivered on the afternoon of February 14, by Sir Henry Howse, president of the Royal College of Science, in the theater of the college. He devoted the greater part of his oration to interesting biographical incidents concerning John Hunter, who was elected a fellow of the Royal Society in 1767, and appointed surgeon-extraordinary to the King in 1776. The collection of the objects in his museum was Hunter's chief interest through many years of his life, and at his death there were 14,000 specimens in the museum, on which Hunter spent 70,000*l*. A banquet took place in the evening in the library of the college, at which the honorary fellowship of the college was conferred on Lord Roberts, who, in his reply, referred to the outbreaks of enteric fever at Bloemfontein and Kroonstad during the late war, and expressed his admiration for the way in which the medical officers managed to meet all emergencies with a minimum of appliances.

It is announced from Washington that Secretary Hitchcock, of the Interior Department, has granted authority for the acquisition of necessary property, rights of way, etc., prior to the construction of irrigation works in five localities. These projects are: Wyoming, Sweetwater dam; Montana, Milk River; Colorado, Gunnison tunnel; Nevada, Truckee; Arizona, Salt River reservoir. These projects are estimated to cost $7,000,000, and will provide for the irrigation of about 600,000 acres of arid land. In addition thereto the Gray Bull reservoir project is to be taken up immediately. The construction remains subject to the feasibility of obtaining the necessary rights and the adjustment of private claims. The authority granted relates to the projects upon which the examinations have been made in sufficient detail to justify estimates of cost

and results. Several others, in other states, are well advanced as regards investigation, and it is expected that further recommendations can be made after the close of the coming field season. The secretary also has authorized the expenditure, during the present calendar year, of $450,000 on surveys, borings for foundations, and other examinations, which will be carried on in all the states and territories included within the provisions of the law.

ACCORDING to a Reuter message from Vienna, Professor Behring, the discoverer of the diphtheria serum, lectured before the Vienna Medical Society upon the results of his experiments with tuberculosis serum, which have so far been confined to animals and have proved entirely successful. The professor at present, however, considers it inadvisable to experiment on human beings. His serum is produced by cultivation of the bacillus of human tuberculosis, which is dried in a vacuum in order to prevent loss of virulence. An ordinary dose consists of four centigrams of bacilli mixed with water. It is injected subcutaneously into the veins. In very few cases, said the lecturer, did the experiments prove unsatisfactory on account of fever, difficulty in breathing, and accelerated pulse, but even in these cases the animals proved immune against animal tuberculosis. Professor Behring found that with younger animals the reaction was less than in the case of older animals, which suffered from severe reaction, besides losing their immunity more quickly. He thought, therefore, that in the event of the serum's proving a success persons should be inoculated in their earliest childhood. Professor Behring admitted that he was unable to tell how soon people might expect to be able to protect themselves against tuberculosis by the injection of serum. Incidentally the lecturer declared that the question of heredity was far less important than many people believed. He attached greater importance to contagion.

THE London *Times* reports that M. Moissan communicated to the French Academy of Sciences at its meeting on March 16 a paper giving the results of an inquiry conducted by himself in collaboration with Professor Dewar into the solidification of fluorine, and its behavior in contact with liquid hydrogen at the temperature of 20 degrees absolute or, say, *minus* 252 degrees centigrade. While one of the collaborators has produced liquid hydrogen in large quantities, the other has isolated fluorine gas in a state of absolute purity, and has demonstrated that this most active of known elements does not attack glass when perfectly free from moisture. Thus it has become possible by sealing pure fluorine in a glass tube and immersing it in liquid hydrogen to show its liquefaction and solidification, and to prove that its point of fusion is at —233 degrees centigrade. It remained only to bring the two elements together at that temperature in order to discover whether chemical activity is entirely suspended as in the case of nearly all other substances. The dangerous experiment was made by breaking the fluorine tube in 100 c.c. of liquid hydrogen, and the result was a violent explosion, accompanied by a volume of flame and the shattering of the apparatus employed. It is thus demonstrated that, whatever may be the case at the absolute zero, certain reactions continue to occur at a temperature only 20 degrees above it when an element so energetic as fluorine is in question.

A REUTER telegram from Vienna, dated March 15, says: "Professor Hans Molisch, of Prague, has reported to the Vienna Academy of Sciences the discovery of a lamp lighted by means of bacteria, which, he claims, will give a powerful light and be free from danger, thus being valuable for work in mines and powder magazines. The lamp consists of a glass jar, in which a lining of saltpetre and gelatine inoculated with bacteria is placed. Two days after inoculation the jar becomes illuminated with a wonderful bluish green light, caused by the innumerable bacteria which have developed in the time. The light will burn brilliantly for from two to three weeks afterwards, diminishing in brightness. It renders faces recognizable at a distance of two yards, and large type is easily legible by it. Professor Molisch asserts that the lamp yields a cold light which is entirely safe."

UNIVERSITY AND EDUCATIONAL NEWS.

The board of regents of the University of Wisconsin on April 21 elected Dr. Charles R. Van Hise, professor of geology, to the presidency of that institution, the term of service to begin with the next academic year, or so soon thereafter as Dr. Van Hise can be freed from existing engagements.

Dr. John H. Finley, professor of politics at Princeton University, has been elected president of the College of the City of New York. Three professors of the college, Robert A. Doremus, chemistry; Solomon W. Wolf, descriptive drawing, and James W. Mason, mathematics, retired with pensions on reaching the age limit.

The building on the campus of Rutgers College, occupied by the New Jersey State Experiment Station and Agricultural College, was almost completely destroyed by fire on April 23. The loss is estimated at $40,000, which is nearly covered by insurance. Most of the collections were saved, but damage was done to those of the botanical and biological departments.

President D. S. Jordan, of Stanford University; President Wheeler, of the University of California, and Dean Norton, of Pomona College, constituting a committee on the award of the Rhodes scholarships from the state of California, have decided that the first scholarship shall be granted to the University of California. The award will be made next winter, and the following year a scholarship will be given a Stanford graduate.

The University of Chicago has established the degree of Bachelor of Education for two years' professional work in the School of Education. Students are to be admitted to the school from the junior colleges of the university and from certain approved high schools.

The Summer School in Mining of McGill University will be held this year in the iron and copper districts of Michigan. The work of the school will be carried out chiefly in the Marquette range, with Ishpeming as headquarters, and in the district about Houghton. In the latter locality the instruction will be given chiefly in the workings and mills of the Atlantic and Baltic mines. On the way west the party will stop at Sudbury and at Sault Ste. Marie to examine the metallurgical plants at these places. The geological work in connection with the school will be done in the Marquette district. The party leaves Montreal in a special car on April 27 and will return about the middle of June. The school will be in charge of Dr. J. B. Porter, professor of mining in McGill University, and the instruction in geological field work will be given by Dr. Frank D. Adams.

About one hundred cases of typhoid fever have occurred at Palo Alto, largely among the students of Stanford University. The disease is, however, of a mild type, only one death having occurred. It was caused by contaminated milk.

Dr. L. A. Bauer, as lecturer in terrestrial magnetism, will give his annual course of instruction in magnetic work at the Johns Hopkins University during the week April 27 to May 2.

John L. Sheldon, of the botanical department of the University of Nebraska, has accepted the position of professor of bacteriology in the West Virginia University, and bacteriologist to the agricultural station. He will assume his new position September 1, and will spend this summer as instructor in botany in the Colorado Springs Summer School. Mr. Sheldon comes up before the faculty of the University of Nebraska in June for the degree of Doctor of Philosophy (in botany).

Mr. Frank L. Hann, who has been assistant in chemistry at Cornell College, Iowa, has been chosen an instructor in the chemical department of Morningside College, at Sioux City.

Dr. Arnold Emch, heretofore assistant professor of pure and applied mathematics in the University of Colorado, has been promoted to a full professorship of graphics and mathematics.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 8, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE ENDOWMENT OF ASTRONOMICAL RESEARCH.

THE unexampled prosperity of the United States, during the past few years, has given it the industrial supremacy of the world in many departments. A similar advance is to be expected in its scientific progress, especially in astronomy, if equal skill is shown in organization and development. The vast fortunes now being accumulated must, during the next few years, lead to gifts and endowments on a scale unparalleled in the past. It is not an easy matter to make large gifts wisely, and probably many of the most brilliant men in the country, having amassed large fortunes, are now trying to decide how they can bestow them to the best advantage. To establish a university of the highest grade a large sum of money is required. For instance, Harvard for many years has had an annual income exceeding a million dollars. To duplicate

the buildings, collections and other parts of the permanent plant, many millions would be needed to equal it even pecuniarily. Even then, a rival institution would be established, which might do more harm than good, since it would draw its students mainly from those who would otherwise go to existing universities.

Astronomy is a science which has always received a large share of such gifts as those mentioned above. Its rapid growth, at the present time, and the brilliant results obtained by the application of photography, spectroscopy and other branches of astrophysics, render it probable that it will still further attract the patrons of science. Unfortunately, in the past, many gifts have been made to astronomy which have not yielded the results expected from them. Thus we had at one time in the United States a great observatory, but no telescope; a great telescope, but no astronomer to use it; and an astronomer whose valuable observations, the results of many long years of hard work, were rendered useless by the lack of a few hundred dollars to publish them. We have still many beautiful observatories, equipped with powerful and expensive telescopes which are idle, and therefore useless, during a large part of the night. These unfortunate results are largely due to lack of consultation with astronomers by prospective donors. Consequently, many gifts have been made from which little return has been obtained.

While, as shown above, there are but few persons with fortunes large enough to establish a university of the first class, a much smaller sum would be required to establish an astronomical institution, whose usefulness would far exceed that of any now existing, especially by utilizing the plant already collected. The five observatories having the largest annual incomes are the U. S. Naval Observatory, $85,000; Paris, $53,000; Greenwich, $49,000; Polkowa, $48,000; Harvard, $50,000. The permanent endowment of the Harvard Observatory has increased from $176,000 to $909,000 during the last quarter of a century. These funds are invested by the treasurer of the university, together with the other funds in his charge, which now exceed $14,000,000. This large sum permits a very advantageous investment to be made, and during the last year the net rate of interest, free from all taxes, has amounted to four and eight tenths per cent. The age of the university, two hundred and sixty-seven years, insures great permanency in its management. It has passed uninjured through the periods of two great wars, and the great fire of Boston in 1872, which was still more disastrous to its supporters. Although the citizens of Boston lost many millions of dollars in this fire, this did not prevent their making good the heavy losses of the university. The strong interest and support of the people of eastern Massachusetts, which has led to their giving many million dollars to Harvard, is the best assurance that money intrusted to it will be spent as the donors wish.

It is estimated that the total sum spent yearly on astronomical research throughout the world amounts to about $500,000. It has been pointed out by Professor Newcomb that an addition to this sum of even $100,000, distributed among existing observatories, might increase the amount of work done, but would not necessarily improve its quality. Owing to the great industrial prosperity of this country, gifts may be expected ten times as large as those of the last century, during which this observatory received three funds exceeding one, two and three hundred thousand dollars, respectively. This seems, therefore, a proper time to consider how a gift of one

or two million dollars, if given to Harvard for astronomical purposes, could be best expended, and to see if the advantages would not prove so great as to induce some lover of science to make this gift. The great sums expended on astronomy in the past have developed elaborate systems of work and expensive instruments, such as have not been furnished in any other science, and have given astronomers a training in carrying on work on a scale not attempted in the other sciences. This, however, renders it necessary to expend large sums in order to attain better results than are now secured, and to make a real advance. It should be pointed out that it is as important to prevent gifts under improper restrictions, as to secure those that can be wisely expended. In the first case, not only is no useful result attained, but other donors are discouraged by seeing money thus wasted. It is also a matter of the greatest importance that the donors should see and appreciate the results attained, so that they may in this way receive a partial return for their enlightened generosity.

The policy of this observatory has been to secure and retain the interest of donors, and, when beginning on a small scale, to obtain results that justified extension. Thus, in 1882, an appropriation of $500 was secured from the Rumford fund, for investigations in astronomical photography. With this a camera of two and a half inches aperture was purchased, and stellar photographs taken, which led to an appropriation of $3,000 from the Bache fund. An eight-inch photographic telescope was procured, and with this thirty thousand 8×10 photographs have been taken. After being used on the northern stars in Cambridge, this instrument was sent to Arequipa, Peru, where it is now used throughout every clear night. The results proved of such value that Mrs. Henry Draper gave a second eight-inch doublet, to replace the Bache telescope in Cambridge. Thirty thousand photographs have been taken with this instrument also. Again the results were used to secure a still larger instrument, and, in 1889, Miss C. W. Bruce gave $50,000 for the construction of a twenty-four-inch photographic doublet, the most powerful instrument of the kind in the world. This instrument is also in successful use at Arequipa. As the photographs increased rapidly in number, the room for their storage and examination proved wholly insufficient. Again the friends of the observatory came forward and provided it with an adequate fire-proof building for their accommodation. Finally, this last year a grant from the Carnegie Institution has given us the means of beginning a systematic study of these plates, and thus extracting a few of the vast multitude of facts accumulated on them.

The three principal sources of income of the observatory, the Paine fund, the Boyden fund and the Henry Draper memorial, were all received after arguments had been presented showing the results obtained on a small scale. Fortunately no restriction was attached to either of these gifts that would interfere with its usefulness, and the income of the observatory can be expended in almost any way that will secure the greatest scientific return.

Another policy of the observatory has been one of cooperation, the last example being in determining the brightness of a system of standards of magnitudes for very faint stars. By the help of an appropriation of $500 from the Rumford fund, suitable photometers have been devised and constructed, and the directors of the Yerkes, Lick and McCormick observatories have courteously cooperated with us, so

that a system of standard stars has been selected and measured, including some of the faintest stars visible in the largest telescopes. In this work, telescopes of 40, 36, 26, 15 and 12 inches aperture, including the two largest telescopes in the world, are working together.

It is also our policy to carry on work in whatever way the greatest scientific return can be secured, whether at Cambridge or elsewhere. A fund of $70,000, of which $10,000 is now available, has been given for this purpose. It may be claimed that it will be difficult to maintain permanently a policy of complete unselfishness, by which astronomers in other countries may be aided whenever they can do a given work better than we can. The answer to this is that no body of trustees is better qualified to enforce such a policy than the president and fellows of Harvard College. Apart from the broad views they have always maintained, it is obvious that they could never afford, with the great interests they have at stake, to fail to carry out the wishes of any donor.

In 1886 a pamphlet, entitled 'A Plan for the Extension of Astronomical Research,' was published by the writer. As a result, in 1890 the sum of six thousand dollars was given by Miss C. W. Bruce, to try the plan for one year, and, out of eighty-six applications, it was distributed as follows:

3. Professor W. W. Payne, Director of the Carleton College Observatory. Illustrations of the Sidereal Messenger.

6. Professor Simon Newcomb, Superintendent of the American Nautical Almanac. Discussion of contact observations of Venus during its transits in 1874 and 1882.

16. Dr. J. Plassmann, Warendorf. For printing observations of meteors and variable stars.

23. Professor H. Bruns, Treasurer of the Astronomische Gesellschaft. To the Astronomische Gesellschaft for the preparation of tables according to Gyldén's method for computing the elements of the asteroids.

27. Professor J. J. Astrand, Director of the Observatory, Bergen, Norway. Tables for solving Kepler's Problem.

29. Professor J. C. Adams, Director of the Cambridge Observatory, England. Spectroscope for the 27-inch telescope of the Cambridge Observatory.

36. Professor A. Hirsch, Secretary of the International Geodetic Association. To send an expedition to the Sandwich Islands to study the annual variation, if any, in latitude.

40. H. H. Turner, Esq., Assistant in Greenwich Observatory. Preparing tables for computing star corrections.

45. Professor Edward S. Holden, Director of the Lick Observatory. Reduction of meridian observations of Struve stars.

46. Professor Lewis Swift, Director of the Warner Observatory. Photographic apparatus for 15-inch telescope.

54. Professor Norman Pogson, Director of Madras Observatory. Publication of old observations of variable stars, planets and asteroids.

57. Dr. Ludwig Struve, Astronomer at Dorpat Observatory. Reduction of observations of occultations during the lunar eclipse of January 28, 1888, collected by the Pulkowa Observatory.

60. Dr. David Gill, Director of the Observatory of the Cape of Good Hope. (1) Reduction of heliometer observations of asteroids. (2) Apparatus for engraving star charts of the Southern Durchmusterung.

78. Professor A. Safarik, Prague. Photometer for measuring variable stars.

79. Professor Henry A. Rowland, Johns Hopkins University. Identification of metals in the solar spectrum.

These examples show how high a grade of application might be expected, and, of course, if successfully carried out, the quality of the work would continually improve.

The following outline of a plan will show how a sum of fifty to one hundred thousand dollars annually could be advantageously expended for astronomy by this observatory. A board of advisers, consisting of several of the leading astronomers of the country, would be appointed, who would meet once a year, or at first oftener, to consider how the available income could

be best expended in order to receive the greatest scientific return.

This board would consist partly of the directors of observatories who could expend portions of the income themselves, and partly of older astronomers who, having retired from active work, could decide without prejudice how the income could be expended to the best advantage by others. They would have authority to add temporarily to their number, astronomers who might be invited to participate in any special work, and who could thus take part in their discussions on equal terms. All expenses of this board would be paid from the income, and except for clerk hire these would be almost the only executive expenses. A circular letter would be sent to all astronomers, inviting application for aid and suggestions for methods of expending the income. If possible, close relations would be established with the trustees of all the research funds which could be used for astronomical purposes, to increase efficiency and avoid duplication of work. The most important duty of the board of advisers would be to consider each year what departments of astronomy were being neglected, and to secure the needed observations, or, if necessary undertake them themselves, or see that they were made at Harvard. As every astronomer is inclined to undertake the work which attracts him most, especially interesting investigations are likely to be duplicated unnecessarily, while laborious or unattractive investigations are neglected. This is particularly objectionable, since in astronomy, a science of observation and not of experiment, an opportunity once missed can in many cases never be recovered. As an example of needless duplication, fifty observatories agreed to observe the planet Eros during its opposition in 1900, but so far as known only two or three have made the reductions needed to render their observations of any value. When a plan was decided on it would be discussed by the entire board, and it is obvious that their combined experience would render serious mistakes less probable than when all depends on the judgment of a single individual, as is now the case. They could find the best man for a given research, and give him the best possible facilities for carrying it on. They could undertake larger and more difficult researches than a single observatory could attempt. It would be the power of many, instead of one, and of large, instead of restricted, resources. The opportunity offered to such a board of advisers, having control of the principal instruments of the country and a large sum of money available to set at work any particular corps of astronomers, ought to secure results far beyond those attainable at any existing observatory. All the advantages of a trust would be secured, with none of its objections. No one could object to a trust in wheat, for example, if its only object was to increase the quality and quantity of the crop, and to furnish it to consumers at the lowest rates, also to aid those not members of the trust in every possible way. In the present case, these conditions would be enforced by a body of men entirely unprejudiced, the corporation of Harvard College. It is universally admitted that in the industrial arts there is a great advantage in cooperation, and in carrying on work on a very large scale. The same remarks apply to scientific investigation, with the added advantage that the supply and demand are indefinitely great, so that the market can never be glutted.

Apart from the advantages to astronomy of such a plan as is here outlined, it is believed that it would serve as a valuable example to the other sciences, and the moral effect of promoting uniformity of purpose,

and friendly aid to one another, by astronomers of all countries, would encourage other donors. An incidental advantage of this plan is that it could be tried on a small scale, as for a single year, and the donor could thus see what results were likely to follow if he made the plan permanent.

Of course, every effort would be made to establish the closest relations with astronomers in general, as the object of the institution could not be attained if the work done was not regarded as advancing astronomical research in the best way. Much might be accomplished through existing societies and periodicals. Another matter of especial importance is that when an astronomer is aided who is qualified to carry on work in the best way, no restrictions should be made on the appropriation, which would in any way interfere with his obtaining the best results.

It will be noticed that this plan differs from those governing existing funds for research, in being active and not passive. While the trustees of other funds wait for applications, and then consider what appropriations can be made, it would be the aim of the advisers of this fund to learn what astronomers desired aid, what instruments now unused were available for work, and what valuable material remained unpublished, and consequently useless, for lack of means. Its special object would be to determine the needs of astronomers, to find what subjects were being neglected, especially those whose usefulness would be lost by delay, and, if possible, to take the necessary steps to secure their execution. Much might be done with existing funds, and it is believed that the trustees of such funds would, in many cases, welcome the means of expending the available income to the best advantage. The opportunities for good work are far in excess of the present means for supplying them. Even the great resources of the Carnegie Institution will be able to respond to only a portion of the excellent applications made to it for aid.

It is most important that unnecessary delays should be avoided. It often happens that an astronomer could undertake a piece of work at once, perhaps during a summer vacation, while after a delay of several months he might be unable to carry it out, or might have lost many of the details then fresh in his mind. This is still more important with large pieces of work. A delay of several years may render a mature astronomer incapable of completing a work which, if undertaken at once, he could carry out with his greatest vigor and skill.

These remarks apply with equal force to the present plan of work. The Harvard Observatory has now the appliances, both intellectual and physical, for undertaking large pieces of work. Several of the leading astronomers of the country are in sympathy with such a plan for cooperation, so that the important methods of organizing and initiating a system could be devised at the present time under very favorable conditions, which may not prevail a few years hence, although the plan, once started, could easily be carried on by others. It therefore seems wise to make a beginning, however small, hoping to show results that will lead to an early fulfilment of the entire plan.

The undersigned, therefore, invites the astronomers of this and other countries to send to him applications for aid. A brief statement of the case in form for publication should be made, generally not exceeding two hundred words in length, with an estimate of the cost, and any additional necessary details. If publication is not desired, it should be stated.

The undersigned will then use his best efforts to secure the execution of such of

these plans as commend themselves to him, reserving the right to omit all others. If the list of applications received seems worthy of it, he will publish and distribute it to possible donors, and will endeavor to secure its publication elsewhere. He will also bring such applications as commend themselves to him to the attention of the officers in charge of the following research funds, with which he is officially connected:

Rumford Fund of the American Academy. Principal, $52,000. Income available to aid American investigators in light and heat.

Elizabeth Thompson Science Fund. Principal, $26,000. Income available for investigators of all countries in all departments of science. Appropriations seldom exceed $300.

Henry Draper Fund of the National Academy. Principal, $6,000. Accumulated income April 15, 1902, $1,515.99. Available for investigations in astronomical physics, by citizens of the United States.

Advancement of Astronomical Science Fund of the Harvard College Observatory. Principal, $70,000, of which $10,000 is now available as stated above. Income may be used for astronomers of any country.

When we consider the great sums at the disposal of the trustees of the Carnegie Institution, and the large unexpended balances of the various research funds of the National Academy, it is not probable that any really worthy investigation requiring only a few hundred dollars for its execution need fail for want of such a sum.

There is another direction in which the writer believes that a great astronomical return could be obtained for a reasonable expenditure of money, some of which is already available. There are, in the United States, many telescopes of large size, which are now in use during only a small portion of every clear night. It is believed that in many cases advanced students in astronomy would be glad to undertake systematic observations with such instruments, for a salary equivalent to a fellowship. They would thus be enabled to continue their studies, and at the same time make valuable additions to our knowledge of astronomy.

Larger investigations may be carried on by the Carnegie Institution, or by private gift. For such investigations the undersigned offers assistance to prospective donors, *if they desire it.* He will, in that case, secure for them the opinions of the leading astronomers of the country, regarding any proposed investigation. A wealthy man, when making a large investment in an industrial enterprise with which he is not familiar, would always obtain the opinion of an expert, for which he would often pay a large sum. How much more important is it in a subject like astronomy, with which he is likely to be still less familiar, that he should learn the views, which would be given freely and without charge, of the principal experts in the country who have devoted their entire lives to the consideration of these subjects.

It is believed that there are many cases where great results could be obtained from a relatively small expenditure. This is illustrated by the following examples:

A Northern Photographic Durchmusterung.—One of the greatest astronomical enterprises of the nineteenth century was the 'Northern Durchmusterung' of Argelander. This consists of a catalogue giving the approximate places and magnitudes of 324,189 stars, north of declination $-2°$, or practically north of the equator. This has been extended by his successor, Schönfeld, to declination $-23°$, including 133,659 stars, and successively to $-32°$, 179,800 stars, $-42°$, 160,415 stars, and $-52°$, 149,447 stars, by Thome at the Cordoba Observatory, where its extension to the South Pole is now in progress. Meanwhile, photographs taken by Gill at the Cape of

Good Hope have been measured by Kapteyn, and have given us the 'Cape Photographic Durchmusterung,' which contains 454,875 stars from $-19°$ to the South Pole. The errors in right ascension, of the positions in the Durchmusterungs of Argelander, Schönfeld and Thome, are about 9″, 6″ and 7″, respectively. The corresponding errors in declination are 26″, 10″ and 14″. The errors in the 'Cape Durchmusterung' are only about 3″ in each coordinate.

Professor Kapteyn, notwithstanding the long and laborious work he did gratuitously on the 'Cape Durchmusterung,' is willing to undertake the supervision of a similar catalogue of the northern stars, thus completing the work for the entire sky. Of course his past experience renders him the one man especially fitted for this work, which he could carry out in Holland so economically that it is probable the work could be completed by the expenditure of $25,000 during the next ten years.

The catalogue would contain about 900,000 stars, and would occupy ten quarto volumes of 300 pages each. Professor Kapteyn also believes that with a new measuring engine, which would cost $2,000, the errors could be reduced from 3″ to 1″. The cost of reduction would thus be increased, but by an amount which could be closely estimated before the work was undertaken. This is perhaps the most advantageous expenditure of money for astronomical purposes that can be made at the present time. The donor would be sure of the constant remembrance and gratitude of future astronomers. The matter is so important that this observatory would undertake to contribute without charge all the photographs needed, as its share of the enterprise.

As another illustration, the Georgetown College Observatory is about to establish a southern station in Rhodesia, South Africa. Father Goetz, S.J., will take charge of this work, and is now on his way. For $3,000 a twelve-inch telescope can be purchased, mounted and used, so that the excellent catalogues and charts of variable stars, completed for northern regions by Father Hagen, could be extended to the South Pole. As the cost of a first-class twelve-inch lens alone is about $3,000, we may regard the mounting, observatory and time of the observer as gratuitous contributions.

If donors could be found who would carry out such schemes as these, it is believed that the supremacy of the United States in astronomy might be placed on a foundation as secure as its industrial supremacy is in any department of work.

In brief, it is proposed to establish an institution in connection with the Harvard Observatory, whose aim should be to advance astronomy as much as possible by making appropriations under the combined advice of the leading astronomers of the country. Much attention would be paid to neglected subjects, especially to those which can not be provided for by later observations, to secure for persons properly qualified the use of powerful telescopes now idle and therefore useless, and, in general, to secure for the person best qualified for any given research the best possible means of carrying it on. It would provide means for cooperation, and would aim at the advancement of astronomy, regardless of country or any personal considerations. The cost of this plan, if fully carried out, would be less than that of a first-class observatory, and it could be fairly tried for a short time, at a moderate expense. For success, it must be wholly unselfish, and, this condition permanently secured, the

investments must be safe and the net income large. It is believed that no guardian would more surely fulfill these conditions than the corporation of Harvard College.

EDWARD C. PICKERING.

CAMBRIDGE, MASS.,
April, 1903.

THE NATURE OF NERVE IRRITABILITY, AND OF CHEMICAL AND ELECTRICAL STIMULATION. PART II.

THE present paper contains results confirming and extending those given in my paper in SCIENCE, Vol. XV., pp. 492–498, 1902. The results previously reported were interpreted to mean that chemical stimulation by salts, apart from the osmotic stimulation of strong solutions, was really an electrical stimulation due to the electric charges of the dissociated ions. Of these ions the negative or anion always tended to stimulate the nerve, while the positive or cathion always tended to reduce nerve irritability and prevent stimulation. Whether any salt stimulated or annihilated nerve irritability without stimulation depended upon the predominance of the anion or the cathion. Chemical stimulation was shown to be in reality electrical, instead of electrical stimulation being chemical as had hitherto been supposed. These results made it possible to understand electrotonus and electrical stimulation. The cathode increases nerve irritability and stimulates, because in this region anions are predominant during the passage of the current; while the anode depresses because here the cathions preponderate. Stimulation on the break of the current was due to the reverse of these processes, the accumulated anions diffusing toward the cathions, and a fall in the positivity of the nerve in the anode region resulting. Furthermore, the specific action of the ions upon the nerve was supposed to be due to a production of a change in state in the colloids in the nerve, extending Loeb's hypothesis in this particular and making it specific that stimulation meant a precipitation of the colloids, inhibition the reverse; the colloids of the motor nerve reacting as if they were electro-positive.

Since the publication of this paper, illness and the pressure of other work have prevented my bringing the matter to a conclusion as soon as I had hoped, and meantime Loeb has published an attack on my hypothesis so far as it applies to muscle.*

Loeb has been led to abandon this hypothesis because of certain exceptions, among them being the action of barium chloride. Further work, of which the following is a preliminary statement, establishes, I believe, the truth of the main conclusions in my former paper, so far at least as motor nerves are concerned. In the case of the muscle I can not but think, from Loeb's results, that a careful study of apparent exceptions might show the same facts there, and explain these exceptions, as has been the case with the nerve. As regards the possibility of sensory nerves showing a different reaction to motor, Grützner long ago pointed out the fact that they were readily stimulated by potassium chloride and acids, while motor nerves were not. Every one knows that acids will stimulate some sensory end organs, presumably by means of the positive ions the acids contain. Knowing these facts, it was easy to infer that sensory nerves were electro-negative and were stimulated by salts having a predominant positive ion, while motor nerves were electro-positive and were stimulated by the anion. Were this true, we should have a positive variation in sensory nerves and a reverse electrotonic effect from that in motor.

* Loeb, *Pflügers Archiv f. die ges. Physiologie*, Bd. 95, 1902, p. 255.

I accordingly tried experiments on the sensory nerve trunks of frogs more than a year ago, but I found the response to sensory stimuli so uncertain as to make the results valueless. Further experiments are necessary before speaking definitely, but thus far I have been unable to obtain any conclusively different results in sensory from motor nerves. I mention this fact to show that the argument that positive ions stimulate sensory end organs is not incompatible with my own conclusions and the facts were well known to me.

1. *The anion stimulates motor nerves; the cathion reduces irritability.* Loeb contradicts this statement for muscle because barium chloride stimulates muscle. The stimulating action he refers to the cathion. Barium chloride of an M/10 or weaker solution will also stimulate motor nerves, and is in these strengths a better stimulus than an equivalent sodium chloride solution. My former statement including barium chloride among the non-stimulants was wrong, the mistake arising from a series of negative observations. Mr. O. H. Brown called my attention to this error. The stimulating action of barium chloride is, however, due to the anion and not to the barium, although barium nitrate and acetate will also stimulate. That it is the chlorine and not the barium which stimulates may be shown by stimulating the nerve or the muscle with non-polarizable mercury, calomel, barium chloride electrodes. If barium stimulates the contraction should begin at the positive electrode on the make of the current, as well as at the negative, for at the anode barium ions are passing into the nerve. It was found that the contraction always began at the cathode on the make as with sodium chloride. The experiment was also tried of soaking the nerve or muscle in barium chloride for many minutes previous to stimulation, so that barium chloride might be present in the muscle and nerve in large amounts. No change in the nature of the response could be observed. Similar experiments with electrodes of aluminum chloride, manganese chloride, magnesium chloride, zinc chloride and other metals gave the same results as sodium chloride, except that a greater depression may occur at the anode. These facts show that the stimulation is due to the anion and not to the cathion.* Further evidence will be given to support this conclusion. Barium chloride resembles sodium chloride in many of its reactions, so that there is little doubt that if the sodium salts stimulate by their anions the barium salts do also. I think it probable that barium chloride stimulates because the two charges on the chlorine overbalance the two charges on the barium. This physiological difference between barium and calcium and sodium and potassium is in line with their chemical behavior. Barium chloride solutions contain no hydrogen ions produced by electrolytic dissociation, while calcium and magnesium do; and potassium chloride, while not containing hydrogen ions itself, facilitates catalyses produced by such ions, while sodium has not this property. Why the two calcium charges are more efficient than the two barium charges is still obscure, but may be due to the charge being more firmly attached to the barium than to the calcium, or that the charge has a different motion in the two cases.

2. *The relative stimulating efficiency of the anions* is primarily, as already stated, proportional to the number of charges on the anions. Further observations on more nerves and other salts show that the monovalent anions are to the divalent and the

* I owe the suggestion of using electrodes in this way to Dr. Lingle, who has already employed it on heart muscle.

trivalent in their stimulating capacity approximately as 1:2+:3.5, and not as Hardy found in colloidal solutions proportional to a power of the valence. There are variations from this rule, some monovalent anions, *i. e.*, hydroxyl, being nearly as powerful as divalent. The formate, however, is not an exception to the rule in the nerve, whatever it may be in muscle. It is, however, somewhat stronger than the chloride. Such variations are in no way antagonistic to the general conclusion that it is the charge which stimulates, and attention was called to them in my original paper. They probably mean that the number of charges is not the sole factor, but possibly, as already suggested, it is rather the motion of the charge around or with the atom or the affinity of the charge for the atom.

3. The general rule that the inhibiting action of the cathion is proportional to its valence or its electrical charges holds true, but here even more than in the anions there are exceptions, monovalent ions sometimes being stronger than one half of a bivalent ion. These exceptions need further study and do not invalidate the general conclusions, for, so far as I have examined, the only bivalent cathion which is weaker than two monovalent anions is barium.

4. That barium chloride stimulates by means of the anion is shown also by the fact that its stimulating action may be neutralized by any of the agents used to neutralize the stimulating action of sodium chloride, *i. e.*, by the addition of small amounts of $CaCl_2$, KCl, LiCl, NH_4Cl and probably other salts having predominant positive ions. More of these salts are required than are required to neutralize NaCl, which agrees exactly with the theory. These facts were predicted, and experiments confirmed the prediction even to the amounts of salts necessary to add. Furthermore, barium chloride, like sodium chloride or other sodium salts, places the end of the nerve in a condition of catelectrotonus, so that if the end of the nerve is cut off after immersion in any of these salts, the muscle goes into a tetanus and may remain in a tetanic contraction for many minutes, in some cases even half an hour. This tetanus corresponds closely to the tetanus observed on cutting the nerve between the electrodes with the anode near the muscle during the passage of the current, and is, I believe, due to the same cause. This similarity of action between sodium and barium salts shows them to act in the same way in the nerve, but the barium salts somewhat more strongly. The fact that barium chloride may be neutralized in its poisonous and stimulating action by calcium chloride is difficult to reconcile with the hypothesis that antitoxic action occurs between monovalent and polyvalent positive ions.

5. If sodium chloride stimulates by the anion, as electrical stimulation clearly indicates, it should be possible to neutralize its stimulating action by adding small amounts of any salt of which the positive ion preponderates, but not by any salt of which the negative ion preponderates. This is the case: The stimulating action of sodium chloride may be neutralized by small amounts of the chlorides of lithium, potassium, hydrogen, ammonium, aluminum, calcium, strontium, zinc, cobalt, manganese or magnesium. The amount of salt necessary to neutralize varied in different cases, more lithium being necessary than potassium. The salts were found to range themselves in this action in the same order of efficiency as previous experiment had shown them to act as depressors of irritability. The order was predicted from the theory and confirmed by experiment. The exact figures will be given in the full

paper. By this method we can arrive at the exact relative physiological efficiency of the different positive ions, and, so far as I have gone, it corresponds closely with the chemical or catalytic action of these ions.

The addition to sodium chloride of any salt of which the anion overbalances more than chlorine does over sodium should not neutralize the poisonous or stimulating action of sodium chloride, but should increase the latter. This is the case: The addition of barium salts, or of sodium sulphate, phosphate, citrate or ammonium citrate increases the stimulating action of sodium chloride.

6. If sodium chloride is poisonous because the chlorine predominates, we should be able to neutralize its poisonous action by predominant positive ion salts, but not by predominant negative ion salts. This is the case so far as observations go: The addition to sodium chloride of small amounts of calcium chloride, as found by Howell, or potassium or lithium, will greatly prolong the life of the nerve immersed in the solution. The toxic and antitoxic action, so far as the nerve is concerned, and I believe in other cases also, is thus shown to be due to a neutralization of a predominant ion by an ion of an opposite charge, and is not due to any antitoxic action between monovalent and divalent positive ions. The stimulating action of the sulphate or citrates can not be referred primarily in my opinion to their precipitation of calcium or rendering it inert. The stimulating action of these salts may be neutralized, for example, by potassium where there is no question of precipitation. The antagonistic action is thus shown to be due probably not to a combination between the toxin and antitoxin, but to the fact that each of these acts on the protoplasm, but in an opposite manner.

7. The theory that positive ions act like the anæsthetics and depress protoplasmic activity or inhibit has been confirmed by observations on the eggs of echinoderms. The anæsthetics liquefy these eggs; liquefaction is also caused by the electric current on the anode side. These results were obtained by Mr. O. H. Brown. Further analogies of action were observed by Dr. Spaulding and will be published shortly. Preliminary experiments on the nerve indicates that this resemblance extends possibly to protoplasmic respiration, salts of a predominant positive ion checking respiration while those of predominant negative ion increase respiration, at least temporarily. My experiments are, however, still too few to enable positive statements to be made.

8. The current of rest of motor nerves shows marked fluctuations if the tip of the nerve is dipped into acids, alkalies or salt solutions. The acids quickly depress the current, alkaline salts increase it. The current may thus be many times abolished by acids and reappear on dipping in sodium hydrate. These results are being carried further. They indicate the general truth of the conclusions of the opposite physiological action of anions and cathions.

9. The results recorded of the antagonistic physiological action of the anions and cathions hold also for the central nervous system and for the kidneys. This work has been done by Dr. S. A. Matthews and Mr. O. H. Brown and others in this laboratory and will be shortly published. They show that the motor nerve is not unique, but that its reaction corresponds to those of many other tissues.

I believe that the exceptions observed by Loeb in muscle may be explained in part by the fact that when a muscle is put into a salt solution it is impossible to state

whether the contractions arise from the nerves, nerve ends, the muscle substance or a disturbance of the electrical equilibrium within the muscle mass. It must not be forgotten also that the relaxation of the muscle is possibly an active process, and, as experiments indicate on cilia, the relaxation may be stimulated by the positive ions, the contraction by the negative, somewhat as Howell suggested for potassium and calcium in the case of muscle. Lingle has already worked in this direction and will no doubt be able to clear up some of the discrepancies.

10. I believe the results so far obtained support strongly the truth of the hypothesis of the antagonistic action of the anions and cathions on protoplasm. They support Loeb's original suggestion of the importance of valence and of my conclusion that in motor nerves and some other tissues the anion stimulates, while the cathion inhibits. They also support the explanation of chemical and electrical stimulation and electrotonus given in my former paper.

11. The results obtained indicate also the truth of the general law, *i. e., the physiological action of any salt is equal to the algebraic sum of the actions of its ions.*

A. P. MATHEWS.

CHICAGO,
March 3, 1903.

STREMMATOGRAPH TESTS. PRINCIPLES AND FACTS RELATING TO THE DISTRIBUTION OF THE STRAINS IN THE BASE OF RAILS UNDER MOVING TRAINS.

BEFORE it was possible to make any tests of precision showing the distribution of the stresses in rails under moving locomotives, it was necessary to improve the tracks, and introduce stiffer rails than were in use prior to 1884. The $4\frac{1}{2}$-inch 65-pound rails, with their splice bars, were too weak to distribute the loads of the locomotives and cars in an efficient manner. While the distribution theoretically follows the same general law in the lighter rails, yet the efficiency is so much less that it is impossible to obtain comparative tests in practice to confirm the theory of the distribution of stresses under locomotives.

On the $4\frac{1}{2}$-inch rails, the heaviest axle loads on passenger locomotives prior to 1889 were about 27,500 pounds. When many miles of the stiffer 5-inch 80-pound rails were in the track, the axle loads were increased to 40,000 pounds per pair of driving wheels.

The stiffer rails permitted better joints, capable of holding up the ends of the rails, which continued the functional action of a rail as a continuous girder to adjacent rails.

After the stiffer rails have been well surfaced in the track, the portion under the driving wheels becomes practically a restrained beam with numerous supports, the front end being held down by the forward truck wheels, and the other portion of the rail by the tender wheels.

The stiffer rails have been laid upon the same road-beds, without increase of width, to distribute laterally the heavier wheel loads to more breadth of road-bed.

The track for steam railroads is by construction flexible, but notwithstanding the high standards of smoothness which have been secured by reducing the looseness of the superstructure and its flexibility to small limits by stiffer rails, it is not a limited flexible structure like a bridge, in which the strains in the members may be analyzed and calculated.

The problem—or series of problems—in reference to the strains in rails and their distribution under moving locomotives and cars, is so complicated by the looseness of the superstructure and the imperfect elasticity of the road-bed, that it has not yielded to mathematical analysis, as for

bridge members. While safety is the paramount question in either the bridge or rails, the conditions of service are so dissimilar that the same rules as to factors of safety do not apply. The bridge must support itself and the imposed load, while the rail is supported and distributes infrequent driving-wheel loads of large intensity of strain for a small fraction of a second. These can be repeated a few times daily and the rails not break, for years of service. In a bridge a strain lasts for several seconds, and must be limited to higher factors of safety.

The rails rest upon the cross-ties, and are spiked with ordinary hook spikes, which form a secure but not a rigid fastening. There is a slight looseness between the rail and the spike, between the rail and the cross-ties, and the latter in the ballast, which becomes decided under the rapid movements of the locomotives, increasing the strains in the rails.

The stremmatograph was designed to record autographically the strains in the base of the rails under moving trains. A series of stremmatograph tests have been made under moving trains in service, principally upon the 80- and 100-pound rails, having three-tie points, of the New York Central & Hudson River Railroad.

At first it was considered that the important problem would be to ascertain the maximum strains to determine the factors of safety in the rails. Numbers of such tests have been made, and it was found that under fast trains, at fifty miles per hour, it was not uncommon to record unit fiber strains in the base of the rails as high as 40,000 or even 45,000 pounds. The elastic limits in the steel of the rails under test run from 55,000 to 60,000 pounds, almost as high as the ultimate strength of bridge and structural steel.

In comparing the results of a number of tests it was noticed that the stresses under similar wheels were not alike, but when the total stresses for the entire locomotive were considered, close approximations were obtained, from two or more locomotives of the same class, when running at the same speed and doing the same work. Then a series of tests was undertaken of the highest precision, to trace the distribution of the stresses under the locomotives. It was found after a number of tests were reduced, that it was possible with two locomotives of the same weight and class, doing like work, the wheels being in perfect condition as to smoothness, to obtain results which would compare within one half of one per cent. when they were taken on the same rail, without any other locomotive passing over the rail in the meantime.

Numbers of stremmatograph tests have been tabulated and studied, from which some principles and facts have been deduced. These principles illustrate particularly the early American theory and practice of distributed wheel loads, and were applied in the inception of our railroads, and are still the basis of our unexcelled practice. They were understood qualitatively, and the railroads constructed in accordance therewith, but were not pointed out specifically, owing to the fact of the inability of making quantitative determinations of the forces transmitted to the rail and road-bed by the moving locomotives and cars. The state of the art rather than the science was the guide for practice.

Seven principles and three facts have been traced, which are true generally as applied to railroads, although high efficiency can not be obtained on tracks of light rails. This does not affect the principles, only the degree of efficiency attained.

One of the earliest efforts of the American engineers, after locomotion had been secured, was to adapt the construction of the wheel base of the locomotive and cars to the track, so that in their movements they would produce as little destructive action as possible. That became the guiding feature in the construction of the early railroads.

The track being a flexible construction, an effort was made to utilize a portion of the wheel base to stiffen a portion of the track for the heavier wheel loads.

Each type of locomotive would make a distinct general depression in the superstructure, as well as specific deflections under the individual wheel loads.

Mr. John B. Jervis, the chief engineer of the Mohawk & Hudson Railroad, in 1831, after the trials with the English locomotives, and also with the 'DeWitt Clinton,' observed that the motion, particularly of the English locomotives, of two pairs of wheels for the wheel base, was very unfavorable not only to the track, but severe for the engineer and fireman. Mr. Jervis was formerly the chief engineer of the Delaware & Hudson Canal Co., and had imported some English engines for use upon that road, when it was to be opened in 1829. The first locomotive made by R. Stephenson & Co., the 'America,' was landed in New York in May, but for some unexplained reason was never sent to the road. Later the 'Stourbridge Lion' arrived, which was constructed by Foster & Rastrick, of Stourbridge, England. This was sent to Honesdale, Pa., and a trial made with it on August 8, 1829. Mr. Horatio Allen, who had formerly been associated with Mr. John B. Jervis, and supervised its construction in England, acted as the engineer. No one else was upon the locomotive. The engine was started and run across the trestlework over the Laxawaxen Creek, and returned without accident. This completed its running, but not its service to American railroads. The engine was too heavy for the track, the weights upon the axles being greater than had been anticipated or prescribed by Mr. Jervis, and the structure was not capable of sustaining the locomotive.

Messrs. Jervis and Allen, after noticing the injury to the track by the 'Stourbridge Lion,' eventually devised entirely different mechanisms for application of the principle of subdividing and distributing the total load of the locomotive to the track. Mr. Horatio Allen designed an eight-wheel engine for the purpose. Each pair of driving wheels was driven by a separate cylinder, but they were not connected so as to keep the cranks at right angles to each other. Mr. Jervis designed, in place of one pair of driving wheels, a flexible four-wheel truck to support the front end of the engine, which served to subdivide the total load of the engine, and connected a pair of driving wheels to the main frame which supported the boiler and machinery of the engine.

While Mr. Allen and Mr. Jervis both had the idea of distributing the total load of the locomotive to a longer portion of the track, each used a different mechanism for applying the principle. The mechanical application of Jervis still survives and is in general use on most of the locomotives in the railroad world.

After three score and ten years of service and experience, the mechanical application of Jervis is the best. Mr. Allen's system was confined to three or four locomotives, and was succeeded on the same railroad by locomotives with the Jervis truck, the first one being named the 'E. L. Miller,' constructed by Mr. Mathias Baldwin, the founder of the Baldwin Locomotive Works.

Mr. Jervis's mechanical application made the state of the art so complete that his theory has been well-nigh forgotten.

The stremmatograph confirms the theory that on tracks of stiff rails and joints, locomotives when drawing their trains distribute their total load and effects of the expended tractive effort in accordance with a principle of mechanics. In the evolution of American locomotives this principle has received its greatest application, not only in more wheels in the wheel base of the engine, but in that of the tender.

The decided advantage of being able to distribute the total load of the locomotive through a number of wheel contacts, enables a heavy load to be carried without unwarranted injury to the track, by making the forward wheels check deflections under the following driving wheels. The drawbar-pull also becomes of assistance in the distribution of the loads on the driving wheels and effects of the expended tractive effort. In this way the combined stability between the locomotive and the superstructure of the permanent way is increased.

The rail is the most important member of the conservative system either of the superstructure of the track or of the permanent way. The bending of the rails is produced directly by the moving wheel loads, and the tension under one wheel contact can not take place without producing compression at some other point. Therefore, bending in either direction is resisted by the metal, which helps distribute the load to a longer portion of the track than is possible on lighter rails.

The combined stability, efficiency and capacity between the locomotive, rolling stock and the permanent way increase in a faster ratio than the direct stiffness between two sections of rails. This is shown by the great increase in the weight of the locomotives and cars in the last few years, running over the same road-beds which were formerly laid with light rails.

The stresses of the specific deflections of the different wheels of the locomotive running over a flexible track are of necessity quite irregular. The irregular application of steam also makes an irregular distribution of the stresses per revolution.

As the smoothness of the track has increased, the realized coefficient of adhesion of the system of the driving-wheel base of the locomotives has also increased.

P. H. Dudley.

SCIENTIFIC BOOKS.

Analytical Chemistry. By F. P. Treadwell. Translated from the second German edition by William T. Hall. Vol. I., 'Qualitative Analysis.' 8vo. Pp. xi + 466. New York, John Wiley & Sons. 1903.

There are so many books on qualitative analysis, and so many of them have little reason for existence, that it is a matter of satisfaction to examine one, like the work under consideration, which possesses many features of novelty and excellence.

The book begins with an introduction explaining general principles, including the law of mass action and the ion theory of Arrhenius. While the latter theory is apparently advocated, its influence is shown but little in the book as a whole. For instance, in the first part of the introduction it is stated that a precipitation always takes place when an insoluble substance is formed by means of a 'chemical decomposition,' and, although the part of the book which treats of acid radicals is headed 'Reactions of the Metalloids (Anions),' the substances dealt with are called 'acids.' This neglect of the modern theory will be approved by some, but it will be objected to by many.

The book seems to be particularly good in its clear and full descriptions of qualitative tests. Many new and improved methods are introduced, and the methods adopted are generally very satisfactory. However, the re-

tention of the calcium sulphate method for testing for barium and strontium, which has been abandoned by Fresenius and others, is open to criticism, and the failure to mention de Koninck's excellent potassium cobaltic nitrite test for potassium seems unfortunate in view of the increasing cost of platinum, and of the fact that the test is much more delicate than the one with hydrochloroplatinic acid. Those who have used Gooch's separations of lithium chloride from sodium and potassium chlorides, and of calcium nitrate from strontium nitrate, by means of amyl alcohol, will regret that they receive no mention here.

A striking and valuable feature of the book is the elaborate treatment of the equations of the reactions. In these equations the formulas are frequently rather elaborately developed according to the theory of valency, a practice which at times seems to involve an unnecessary waste of space, on account of the uncertainty of the positions of the atoms in the inorganic compounds.

The part on the acids is unusually full and extensive, including a number of acids that are not usually considered in the text-books. There is a supplement, also, which deals with the rarer metals.

Analytical tables, to which some teachers object, are freely used, but it is stated that in the author's experience these have given the best results.

The translation appears to have been very well done, but a number of errors, particularly in the equations, indicate some lack of care in proof-reading. H. L. W.

The Movements and Reactions of Fresh-water Planarians: A Study in Animal Behaviour. By RAYMOND PEARL, Ph.D. *The Quarterly Journal of Microscopical Science.* Vol. 46, 1903, pp. 509–714.

This paper from the zoological laboratory of the University of Michigan gives a detailed account of a very thorough and careful study of the behavior of planarians. Dr. Pearl states in his introduction that it is his purpose to give such a complete account of his observations that no desired information concerning the work shall be lacking. In America, especially among physiologists, the tendency is to limit papers to the bare statement of results; details of method and observation are omitted. This Dr. Pearl considers an unfortunate tendency; he, therefore, presents a minutely descriptive paper. But even two hundred pages on planarian behavior are not tiresome in this case, for the paper is written with a noteworthy clearness, accuracy and precision of statement. Everywhere it inspires confidence in the reliability of the observations and experiments. The author's painstaking care, resourcefulness and enthusiasm for research are unmistakable. Although Dr. Pearl is evidently responsible for the whole of this study, he gives generous thanks to Professor Herbert S. Jennings for suggestions, criticisms and general helpfulness. Professor Jennings is really the pioneer in the analytic study of animal behavior in this country, and his excellent work on the reactions of unicellular organisms is inspiring many to research along similar lines.

In the paper at hand we find the following chapters: (1) 'A Résumé of the Literature Bearing on the Subject,' (2) 'A Discussion of the Habits and Natural History of Planarians,' (3) 'A Description of the Normal Activities of the Animals,' and (4) 'A Consideration of Their Reactions to Stimuli.' In this chapter the author deals with: (*a*) reactions to mechanical stimuli, (*b*) reactions to food and other chemical stimuli, (*c*) thigmotactic and righting reactions, (*d*) reactions to an electric current, (*e*) reactions to desiccation, and (*f*) reactions to currents of water (rheotaxis).

Throughout the investigation Dr. Pearl's aim has been to analyze all the reactions into their reflex components and to describe the mechanism of each reaction. Briefly stated, the most important results of the investigation are as follows: (1) The normal locomotor movements of planarians are two: *gliding,* by the beating of the cilia on the ventral surface, and *crawling,* due to longitudinal waves of muscular contraction. (2) The animals fa-

tigue quickly and periods of rest alternate with periods of activity, as in more highly organized animals. (3) There is surprising sensitiveness to mechanical stimuli; it is found that even touching the surface of the water near the animal with a needle point causes a visible reaction. (4) Two types of reaction are given to stimuli: the *positive,* which is called forth by weak unilateral stimulation of the head region, serves to take the animal toward the stimulus (important for the obtaining of food); the *negative,* which results from strong stimulation of one side of the anterior region of the body, evidently serves to take the animal away from harmful stimuli. (5) Dr. Pearl calls attention to the fact that *intensity* and *not quality* of stimulation determines which kind of reaction shall be given. In case of all chemicals whose effects were studied it was found that to all solutions above a certain strength the negative reaction was given; to those below, the positive. (6) The reactions to chemicals are practically identical with those to mechanical stimuli. (7) There is no evidence that planarians orient themselves with reference to the lines of diffusing ions of a chemical; instead the reactions are merely repetitions of the positive and negative reactions mentioned. A planarian in the neighborhood of a piece of meat does not turn directly toward the food substance, thus bringing its long axis parallel to the diffusion lines of the substance, but glides along without any evident uniformity of relation to the lines. If it chances to be headed toward the meat when it enters the region of diffusion it obtains the food directly, if not, it continues its forward movement until it is stimulated to give the positive reaction. Thus, the forward gliding followed by the positive reaction may be repeated several times before the organism happens to come in contact with the food substance. (8) The ventral surface of planarians is strongly positively thigmotactic, whereas the dorsal surface is negatively thigmotactic; hence, when turned over so that the dorsal surface is in contact with a solid, the animal immediately rights itself by an extension of the edge of the body which is in contact with the solid. The analysis of the righting reaction given by the author is admirable. (9) The reaction to a constant electric current consists of a turning of the head toward the kathode.

As the author says: "All the normal reactions to stimuli are of the nature of reflexes, more or less complex. What the animal will do after a given stimulus, or in a given situation, can be predicted with reasonable certainty. There is, however, some variation in the behaviour, depending on the physiological or tonic condition of the individual at the time of stimulation. Thus a stimulus sufficiently weak to induce the positive reaction in one specimen may cause the negative reaction in another; or at different times the same individual may show different reactions—either the positive or negative—to the same stimulus" (p. 703).

Concerning the psychological position of planaria Dr. Pearl makes some very sane remarks. His study enables him to say that the reactions of this flat-worm are much more complicated than those of the unicellular organisms as described by Professor Jennings. There is, moreover, a certain amount of variability and adjustment to the demands of a situation. The chief function of the planarian brain is the 'preservation of the tonus of the organism,' while the main function of the nervous system as a whole is 'the rapid conduction of impulses.' Dr. Pearl says he does not think we can say whether the worms possess consciousness or not. And he adds: "Any 'objective criterion' of consciousness does not exist." He might well have said that *no such criterion is possible.*

One might with some cause criticise the paper on the ground of undesirable prolixity. The author has everywhere given full descriptions of his methods and results, and in addition he frequently gives diagrams to illustrate the reactions. Sometimes these diagrams are quite unnecessary in view of the simplicity of the reaction and the clearness of the verbal description. There is also unnecessary repetition throughout the paper. The author has gone to the opposite extreme, in his effort to avoid the omission of significant details.

For the work itself we have only praise. It is an important contribution to comparative physiology.

Robert Yerkes.

Harvard University.

A Course in Invertebrate Zoology. A Guide to the Dissection and Comparative Study of Invertebrate Animals. By Henry Sherring Pratt, Professor of Biology at Haverford College and Instructor in Comparative Anatomy at the Marine Biological Laboratory of the Brooklyn Institute of Arts and Sciences at Cold Spring Harbor, L. I. Boston, Ginn & Co. 1902.

Dr. Pratt's 'Invertebrate Zoology' is strictly a laboratory book, intended to give the student all the information and directions which are needed for the intelligent laboratory study of animals, and nothing more. In this the author has as a rule succeeded admirably. His attempt is to give such practical directions that the student can go on with his work profitably without having an instructor at his elbow. In carrying out this attempt he has not hesitated to give directly such information as is necessary to enable the student to do the work intelligently, and has not attempted to disguise his information under the form of questions—a ruse which has proved so disfiguring to many of the recent laboratory manuals. The absence of pedagogical fads is in fact noticeable and refreshing. The information given is chosen judiciously to accomplish the purpose for which it is intended. There are no figures in the book, as the laboratory work takes largely the form of drawing the careful dissections made, and the author has doubtless experienced the strong tendency of students to imitate the figures of the text. Commendably explicit directions are given for making these drawings.

The plan adopted is to study each one of the larger groups of invertebrates as a whole, several of its representatives being dissected in such a way as to bring out relationships. The first group taken up is the Arthropoda, including study of a wasp, a beetle, a grasshopper, a caterpillar, a centiped, the crayfish or lobster, a crab, a sow-bug, an amphipod, *Caprella,* larval decapods, a copepod, *Daphnia,* and a nauplius larva. Somewhat less extensive studies are undertaken of the Annelida, the flatworms, Bryozoa, Mollusca, Tunicata, Echinodermata, Cnidaria, sponges and Protozoa. While the directions are comparative, the author has tried to make those for each organism complete, so that every teacher may take up the forms in such order as he chooses. Doubtless most teachers would desire to modify the directions in some points to suit their own methods of work; a lack of precision to be noticed in some cases in the directions for the dissection of some of the more difficult systems of organs may thus be remedied. The main body of the book is followed by an outline of animal classification and a glossary of the terms used in the directions.

The book will certainly be found very useful both to teachers of invertebrate zoology and to those attempting without the aid of a teacher to obtain some practical knowledge of the anatomy of invertebrates. While the well prepared teacher can usually work best with laboratory directions which he has himself prepared, even this class will find the book suggestive and helpful.

H. S. Jennings.

Ann Arbor, Mich.,
April 16, 1903.

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 141st meeting of the society, held in the assembly hall of the Cosmos Club, Wednesday evening, March 25, 1903, three interesting papers were presented.

Under the title 'Statics of a Tidal Glacier,' Mr. G. K. Gilbert said in part:

"An iceberg floats in sea water with about seven eighths of its mass submerged. A glacier entering an arm of the sea with a depth less than seven eighths the thickness of the ice continues to rest on the bottom. In the discussion of the origin of fiords it is generally assumed that such a glacier is partly sustained by the sea water, and that the rock bed is to the same extent relieved of ice pres-

sure. A little consideration shows that the water pressure against the vertical front of the glacier has no sustaining power. The ice can be hydrostatically supported only through pressure communicated to its under surface. If there is water contact throughout the base of the glacier, then no share of the weight of the ice is directly borne by the rock bed, but the whole weight comes upon the water; and since earth heat keeps the base of a glacier at the temperature of melting, there must always be a film of water beneath it. This film is not expelled by the pressure to which it is subjected, but is reduced to capillary thinness. It does not obey the hydrostatic law, but the laws of surface tension. The molecular forces associated with its two contact surfaces are dominant, and give it quasi-solid properties. The film sustains the whole weight of the superincumbent ice, and communicates its pressure to the rock bed, and this without reference to the absence or presence of sea water. The pressure conditions at the base of the tidal glacier are practically the same in its tidal portion and its land portion, and it has the same power to erode its bed below sea level as above."

It follows, as a corollary, that the existence of a fiord is not *prima facie* evidence that the land had a different relation to sea level at the time of its excavation.

Mr. Whitman Cross, 'Observations on Hawaiian Geology.'

Mr. Cross gave a brief sketch of the geology of the Hawaiian Islands, and described the small but interesting eruptions of Kilauea which have occurred within the past year. Special attention was called to the long series of eruptions of basaltic lavas which has continued from some unknown date in the Tertiary to the present time. That no other lavas should have alternated with basalt and that no apparent progressive change in the characters of the lavas has taken place, contrasts markedly with the history of most volcanic centers. The discovery of trachytic rocks at one point on the island of Hawaii, announced by Mr. Cross, is but the exception proving the rule. In all the older, much dissected islands, no such unusual lavas have been found.

Mr. Cross spoke of the exceptional opportunities for the study of physiographic processes, since the various islands exhibit all stages in the sculpturing and degradation of volcanic mountains from the unmodified dome of Mauna Loa to the islet, hardly more than a reef, the remnant of a former basaltic volcano.

The recent eruptive activity of Kilauea, beginning in June, 1902, was confined to the pit crater of Halemaumau. This pit is 1,200 to 1,500 feet in diameter, and was about 1,000 feet deep before the lava appeared in its bottom, last June. The sum total of many small gushes of lava up to the end of 1902 was enough to fill up the pit to a distance between 700 and 800 feet below the crater rim.

Mr. Bailey Willis, 'Post-Tertiary Deformation of the Cascade Range.'

Mr. Willis discussed the form of the mountain block which had been elevated (or left in relief through general subsidence) in the development of the Cascade Range. The conception of form was arrived at through study of a warped peneplain of post-Miocene age, which over a wide area is now elevated to altitudes of 3,000 to 8,500 feet. The criteria applied to test the deductions as to form are of a physiographic nature; streams are found to be in part antecedent, in part consequent, and in part adjusted through piracy. In valley profiles there are recognized monadnocks, the peneplain, the post-peneplain mature topography, and the still later canyon topography, the last antedating the latest glacial epoch. Lake Chelan, the central feature of the district discussed, is found to have a complex history, having developed through stream robbing as an extensive canyon, and having been excavated to a depth of a thousand feet below its rock rim by glacial erosion, under peculiar conditions of constriction and pressure of the ice.

The subject discussed will be illustrated in a forthcoming professional paper of the Geological Survey. W. C. Mendenhall,
Secretary.

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

THE third meeting of the Society for Experimental Biology and Medicine was held on the evening of April 15, in Professor Graham Lusk's laboratory at the University and Bellevue Hospital Medical College, New York City. Dr. S. J. Meltzer presided.

In harmony with the aims of the society the evening was devoted mainly to reports of original work done by the members, with demonstrations of methods and results. The program was as follows: *

I. REPORTS OF ORIGINAL WORK, WITH DEMONSTRATIONS.

Changes in the Blood-volume of the Vein of the Submaxillary Gland on Stimulation of the Chorda Tympani and Sympathetic Nerves: R. Burton-Opitz.

Dr. Burton-Opitz explained the mechanism of a recording stromuhr by means of which he made quantitative determinations of the blood flow in the vein conveying the blood from the submaxillary gland. The blood-volume was measured previous to, as well as during, the stimulation of the secretory nerves. The curves which were exhibited showed very striking changes in the blood-flow, namely, an increase on stimulation of the chorda and a decrease when the current was applied to the sympathetic fibers. In the former case the volume of the blood flow (cubic centimeters per second) was from about two to nearly six times as great as normal, and in the latter case it was from about one half to one fifth the normal volume. By using a strong stimulus a complete cessation of flow can be produced.

* The secretary has received an abstract of each report from the member making it, and in editing these abstracts has made only occasional verbal and minor alterations in them, such as abbreviations and the like. The abstracts here given are in fact, therefore, the contributions of the several members themselves, and should be so credited. This statement applies to the former report also (SCIENCE, XVII., p. 468), and will be true of those in the future.

Does a Backward Flow ever occur in the Veins?: R. Burton-Opitz.

The results of this investigation may be summarized as follows: A backward swaying of the column of blood in the central veins is a constant, normal phenomenon. It is produced by two factors: first, by the contraction of the right side of the heart, and secondly, by high intra-thoracic pressure (forced expiration). If the distal conditions in the venous system are favorable, this backward movement can also be obtained in the peripheral veins (femoral vein). The same instrument was used in this investigation as in the former.

A New Method of Studying Metabolism: Gary N. Calkins.

Dr. Calkins described experiments now in progress upon metabolism in unicellular animal organisms. These forms, reproducing by simple division, offer the same protoplasm for study, generation after generation, and, with each division, the daughter organisms, by reason of the functions of regulation and regeneration, perfect themselves in the race-type, while digestion, assimilation, waste, repair and growth are handed down unchanged from cell to cell. The problem is to ascertain whether these various functions will continue their activities indefinitely or whether protoplasmic old age will supervene to put an end to the race. In nature such an end is prevented by sexual union, whereby the conjugating organisms are rejuvenated.

In the experiments this function was prevented by isolation. The general metabolic functions *wore out* four consecutive times at intervals of six months, and each time, except the last, the race was saved only by a change in diet or by chemical stimuli. The phenomena were analogous to those in the artificial fertilization experiments of Loeb and others, with this difference, that, if comparable with artificial parthenogenesis, the process was repeated with the same protoplasm three consecutive times. In the fourth period of degeneration the stimuli previously tried were no longer effective and the race died out, 742 generations old. Structural changes were different in the different periods of depression.

The degenerate animals, in the periods which were successfully overcome, had curiously altered nuclei and endoplasm. In the last period of depression which was not overcome, the nucleus and endoplasm were normal, while abnormal parts were found in the micronucleus and the cortical plasm.

The conclusions which this part of the work seems to justify are: (1) That 'old age,' so-called, of the cell, may be due either to the wearing out of functions, or to the degeneration of structural parts. The former is capable of artificial rejuvenescence, the latter apparently not. (2) The ordinary functions of metabolism, such as digestion, assimilation, excretion, growth, etc., are dependent upon certain definite portions of the cell (macronucleus and endoplasm), while the dividing energy is a function of the micronucleus and of the cortical plasm. (3) After conjugation, the organisms start with high potentials of metabolic energy which gradually wear out, but which can be restored artificially. So, too, the dividing energy starts with a high initial potential energy, but which can not be restored after exhaustion.

In the light of these experiments it would be pertinent and instructive to ascertain whether artificial parthenogenesis, in sea-urchins for example, could be repeated more than once on the same continuous protoplasm. On *a priori* grounds a successful result would be extremely doubtful.

On the Origin of Cholesterin in Gall-stones: C. A. Herter.

Dr. Herter said that experiments made in his laboratory by Dr. Wakeman give strong support to the view that inflammatory conditions of the walls of the gall-bladder may lead to an increase in the cholesterin of the bile. Dr. Wakeman injected strong solutions of bichloride of mercury into the gall-bladders of dogs previously starved for three days. After periods of from two to five days the animals were killed. As a rule, the gall-bladder walls were much thickened and the epithelium was proliferated and desquamated. The solids of the bile were diminished in percentage. The cholesterin content was much increased. The contents of the gall-bladder in these experiments were sterile. These facts are of great interest in relation to the etiology of gall-stones.

On Nucleic Acid: P. A. Levene.

According to Osborne, nucleic acid derived from the plant cell differs from that of the animal cell with variation in the characters of the pyrimidin base present in its molecule. Dr. Levene has devised a new method of separating the pyrimidin bases, in which he avoids the precipitation with silver. With this method he has obtained from the animal nucleic acid (derived from the spleen and pancreas), besides thymin and cytosin, also uracil. The radicle of the latter substance had been supposed to occur only in the plant nucleic acid. Kossel and Stendel have made the same observation in regard to the nucleic acids derived from the thymus gland and from fish sperm.

Respiration Experiments in Phlorhizin Diabetes: Graham Lusk (with A. R. Mandel).

An experiment on a diabetic dog showed that whether fasting, or fed on meat alone, or on meat and fat, no more fat was burned than in the same dog when he was normal and fasting.

A Modified Eck Fistula, with a Note on Adrenalin Glycœmia: A. N. Richards.

A method devised by Vosburgh and Richards for establishing communication between the portal vein and the inferior vena cava of the dog was described and demonstrated. In this method two cannulas are employed. They are constructed on the same principle as the one used by Vosburgh and Richards in collecting blood from the hepatic and portal veins without interfering with the normal circulation in those vessels (*Amer. Journ. Physiol.*, 1903, IX., p. 43). After suitable incision through the abdominal wall a cannula of that type, 1 cm. long, was inserted into the portal vein about 2 cm. below the entrance of the pancreatico-duodenalis. A second cannula of similar design was introduced into the vena cava at a corresponding point. By connecting the cannulas with a rubber tube, communication was established between the two vessels. On ligating the hepatic arteries and the portal vein at the

hilum of the liver, circulation through the liver ceased and the gland was extirpated.

By the successful use of this method Vosburgh and Richards have found that the application of adrenalin to the surface of the pancreas brings about a slight rise in the sugar content of the blood even after extirpation of the liver. Their experiments thus far have covered periods of from two to three hours, no systematic attempts having yet been made to get the animals to survive the operation.

II. REVIEW.

Aims and Achievements in Recent Experimental Cytology: Gary N. Calkins.

A review of Loeb's, Wilson's and Boveri's experimental researches.

WILLIAM J. GIES,
Secretary.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF BIOLOGY.

THE fourth meeting of the year was held at the American Museum of Natural History on April 13, Professor Bashford Dean presiding. Papers were read by Dr. A. G. Mayer on 'The Instincts of Lepidoptera' and Professor H. E. Crampton on 'Variation and Reproductive Selection in Saturnid Moths.' Abstracts of these papers follow.

The paper presented by Dr. Mayer was a mere preliminary account of certain observations made by the writer. It is planned that the research will be continued and finally published conjointly with Miss Caroline G. Soule. Certain lepidopterous larvæ, such as *Danais plexippus,* are negatively geotactic and positively phototactic toward the ultra-violet rays. The combination of these reactions in nature maintains the larva at or near the top of its food plant, where, incidentally, it finds the youngest and best leaves, and tends to prevent its crawling down and away from the plant, thus incurring risk of starvation. Other larvæ, such as *Pyrrharctia isabella,* are indifferent either to the attraction of gravitation or to ordinary variation in conditions of light. Others react differently at different stages of development. Larvæ which will devour only certain definite species of leaves may be induced to eat sparingly of any other sort, provided the instinct to eat be first set into operation by the presence of the proper food plant. Under such conditions about the same number of bites are taken upon each presentation of the uneatable food to the larva. This phenomenon may be called 'momentum of the reaction,' and inclines one to conclude that the eating reaction is probably an unconscious reflex. Another series of experiments appeared to show that larvæ are unable to learn to follow a definite path to their food, and that the associative memory of lepidopterous larvæ does not endure for as long a time as ninety seconds. Certain larvæ when about to pupate display a well-marked geotropism.

The mating instinct is called into play by the perception of the characteristic odor of the female, and is merely a phenomenon of chemotaxis uncomplicated by æsthetic appreciation or sexual selection on the part of the female.

Professor Crampton described briefly the principal results of a statistical study of the correlation between structural characteristics and reproductive ability or disability in *Samia cecropia.* It was shown that the pupæ of those individuals, male and female, which mated were different from those which failed to mate, although all were placed under the same conditions as far as possible. True reproductive selection was evident, and related to typical conditions as well as to variabilities. A brief discussion was given of the real basis for the selective process and of the relation between reproductive selection manifested after emergence to that selection which occurred during pupal existence.

M. A. BIGELOW,
Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

AT the meeting of the section on April 6, P. H. Dudley, C.E., Ph.D., of the New York Central and Hudson River Railroad, read a paper full of interest to those familiar with American railroad methods, on 'Stremmato-

graph Tests: Principles and Facts Relating to the Distribution of the Strains in the Base of Rails under Moving Trains.' This paper is published above.

S. A. Mitchell,
Secretary.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

March 27.—Professor Grabau reviewed a paper by F. Noetling on 'Beiträge zur morphologie der Pelecypoden' (*Neues Jahrbuch*, 1902). Mr. C. W. Dickson reviewed the Quebec Group, especially in reference to its history and correlation.

April 3.—Professor Kemp reviewed several late papers from the *Transactions of the American Institute of Mining Engineers.*

April 17.—Professor Kemp exhibited and made a few remarks on the late folios of the U. S. Geological Survey. He also gave a short summary of 'The Two Islands,' an interesting book by Professor Thomas Condon, professor in geology in the University of Oregon. Professor Condon discussed in a semi-popular manner the geological history of these Archean islands, the one in the southeast and the other in the northwest part of Oregon. Dr. G. I. Finlay reviewed a paper by W. M. Davis on the 'River Terraces in New England' (*Bull. of Mus. of Comp. Zool.*, Vol. 38). Mr. C. W. Dickson reviewed several late papers from the American Institute of Mining Engineers. H. W. Shimer.

AMERICAN CHEMICAL SOCIETY.

NORTHEASTERN SECTION.

The forty-fourth regular meeting of the section was held at the rooms of the Technology Club, Boston, Friday, April 24, at 8 P.M. President A. H. Gill in the chair. Seventy-five members were present.

Mr. George W. Priest addressed the section on 'The Manufacture of Chrome Leather,' describing the usual method of preparing the raw hide for tanning, and the two methods used for chrome tanning, known as the one-bath and two-bath processes. The lecturer also described the new process for making patent leather from chrome-tanned skins, and exhibited specimens of leather tanned in various ways. The address was followed by a general discussion of the subject by members interested in the tanning industry.

Arthur M. Comey,
Secretary.

PSYCHOLOGICAL CLUB OF CORNELL UNIVERSITY.

The following papers have been read during the session of 1903:

Mr. B. L. Andrews: 'Tests of Audition: Clinical, Anthropometrical, Psychophysical.'

Dr. J. W. Baird: 'The Influence of Convergence and Accommodation upon the Perception of the Third Dimension.'

Professor I. M. Bentley: 'Clearness as an Attribute of Sensation'; 'Experimental Æsthetics.'

Dr. L. P. Boggs: 'Mental Elements and Mental Units.'

Dr. M. E. Schallenberger: 'Mind in the First Week of Infancy.'

Mr. H. C. Stevens: 'The Physiological Factors in the Normal Plethysmogram.'

Professor Titchener: 'The Method of Minimal Changes'; 'The Law of Error'; 'The Method of Average Error'; 'The Method of Right and Wrong Cases.'

DISCUSSION AND CORRESPONDENCE.

WALBAUM AND BINOMIALISM.

Mr. Henry W. Fowler, in Science for April 10, 1903 (p. 595), has expressed the opinion that 'Walbaum is non-binomial.' This assertion involves the names of many of our most common fishes and would necessitate numerous changes in nomenclature if true. Therefore, a restatement of facts in question appears to be called for. In fact, Walbaum is as binomial as Linnæus, if not more so.

Linnæus himself did not regard what is now called binomial nomenclature of much importance; indeed, he considered it to be simply a device for temporary purposes or for the facilitation of tabulation. What he did take pride in and credit for was the use of the specific name ('nomen specificum'), but this so-called name was not binomial, but of the nature of a diagnosis; really it was a diagnosis, as he claims: 'Nomen specificum est itaque differentia essentialis.' This was his boast: 'Primus incepi nomina specifica es-

sentialis condere, ante me nulla differentia digna exstitit.' What is now known as a binomial name was called by Linnæus a 'nomen triviale,' and he regarded it as of trivial importance. Indeed, he contemptuously accredited his predecessors with the use of such; he expressly affirmed, 'Trivialia erant antecessorum et maxime trivialia erant antiquissimorum botanicorum nomina.'

In the 'Systema Naturæ,' the 'nomen specificum,' or diagnosis, was given the prime place in the text in connection with each species under the generic diagnosis, and the 'nomen triviale' was thrown in on the margin of the page so that it should readily catch the eye. The treatment of one and the same genus by Linnæus in the 'Systema Naturæ,' by Artedi in his 'Genera Piscium,' and by Walbaum in his edition of Artedi's work, will illustrate. *Cobitis,* the second of the Artedian genera, will do.

By Linnæus, the species were thus named:

149. COBITIS. [Diagnosis follows.]

Anableps. 1. C. capite inermi depresso, oculis prominulis.

Barbatula. 2. C. cirris oris 6, capite inermi compresso.

Taenia. 3. C. cirris oris 6, spina suboculari.

fossilis. 4. C. cirris oris 8, spina supra-oculari.

These corresponded to the three species of Artedi named by him as follows:

1. Cobitis *aculeo bifurco infra utrumque oculum* [etc.] (*a*).

2. Cobitis *tota glabra maculosa* [etc.] (*b*).

3. Cobitis *coerulescens;* [etc.] (*c*).

In footnotes, Walbaum coordinates these with the Linnæan names as follows:

(*a*) 1. Cobitis, *Taenia,* cirris 6; spina suboculari. *L. S. N.* 499.

[Diagnosis follows.]

(*b*) 2. Cobitis *Barbatula,* cirris 6; capite inermi, compresso. *L. S. N.* 499.

[Diagnosis follows.]

(*c*) 3. Cobitis, *fossilis,* cirris octo; spina superoculari. *L. S. N.* 500.

[Diagnosis follows.]

Walbaum then added several later discovered species and continued the numeration from the Artedian system. The additions were:

4. Cobitis, *Anableps;* Vide in sequentibus genus Anableps *Artedi.*

The reference is to page 160, where Walbaum calls the species 'Cobitis, *Anableps*' [etc.], refusing to adopt the genus *Anableps.*

5. Cobitis, *heteroclita,* capite imberbi; [etc.].

6. Cobitis, *japonica. Iapanse Meirshlang. Hoattuyn* [Houttuyn, etc.].

After these he added several species he considered for the present doubtful ('*Species adhuc dubiae*'), but continued the numeration:

7. COBITIS, *macrolepidota,* albo fasciata. *W.*

8. COBITIS, *majalis,* nigro in longitudinem et ad caudam transversim lineatus. *W.*

These species are at present mostly known by the following names:

1. Cobitis taenia.
2. Nemochilus barbatula.
3. Misgurnus fossilis.
4. Anableps anableps.
5. Fundulus heteroclitus.
6. Saurida argyrophanes?
7. Fundulus heteroclitus macrolepidotus.

Now it will appear, from a comparison of the names used by Walbaum and Linnæus, that Walbaum acted more in conformity with the present usage of naturalists than did Linnæus. He placed the 'nomen triviale' immediately after the generic name and before the diagnosis, indicating its character by italics generally and its interposition between the generic name and 'nomen specificum' or diagnosis, by commas. In other words, Walbaum interpolated the 'nomen triviale,' while Linnæus was wont to put it by the side.

The 'Genera Piscium' was well edited by Walbaum (or Wallbaum, as he often called himself). He gave the text as it was left by Linnæus and indicated the original pages by marginal numbers. He brought the work up to date by additions given in foot-names, which consequently greatly added to the volume. He has been recognized by all authors as a binomialist till Mr. Fowler challenged his right to be considered such, and a binomialist he certainly was.

In the typographical expression of the

synonymy of the species mentioned, Mr. Fowler has committed an assault upon typographical custom which ought almost to have caused a strike among the printers and must have excited the disgust of the proof-reader. Such a monstrosity as '*C.*(*ephaloptera*) *vampyrus*,' or even '(*Raja.*) *Manatia*,' unhappily, is not unparalleled, but because it is not, and a bad example had been set before, a protest now is all the more timely. Some deference should be paid to the reader, and if he is not intelligent enough to know that *C*[*ephaloptera*] *vampyrus* is the full expression of *C. vampyrus*, and that the bracketed letters were substituted for the period, indicating abbreviation, he certainly would not be intelligent enough to appreciate any part of the article in question. Such flagrant abuses of typographical methods should not be tolerated. The first volume of an otherwise excellent work by a distinguished naturalist was recently published marred by similar blemishes, but the author relieved himself of such eccentricities in the succeeding volume. It is to be hoped that Mr. Fowler will profit by the later example in the same measure as he was misled by the former.

It is proper to add that Mr. Fowler and his predecessor were simply actuated by a laudable desire for perfection of quotation in their strange typographical devices, but surely there should be some limit to deviation from customary methods and to pandering to ignorant and incompetent students.

Theo. Gill.

Cosmos Club, Washington.

THE NEW MEXICO NORMAL UNIVERSITY.

The whole faculty of the New Mexico Normal University resigns at the end of the present school year, under circumstances which should be widely known. Predatory organizations of a political character exist in New Mexico as elsewhere, and it is in the nature of things that they should interfere in various ways and degrees with educational institutions. During my connection with the New Mexico Agricultural College (1893–1900) I had many opportunities for learning the character and motives of this interference, and the time may come when it will be expedient to tell the story in some detail. Some idea of the prevalent conditions may be gathered from the fact that within a period of eight years (1894–1901) the college had five successive presidents, namely, Hadley, McCrea, Jordan, Sanders and Foster. In spite of everything, a great deal of good and useful work was done; but it was lamentable to see the waste of opportunity, time and money resulting from the actions of self-interested, ignorant and prejudiced people. I have before me copies of the letter of Dr. Sanders, fourth president of the college, to his board of regents, and of his second annual report, both written in 1901. In these carefully prepared and exceedingly outspoken documents the case against the politicians is presented in the clearest manner, with abundant details; but they are too voluminous to be published in Science.

The Turkish have a proverb: 'The fish stinks from the head.' It can not be overlooked that the governors of New Mexico, who appoint the regents of the higher institutions, are responsible for the generally unsatisfactory character of these bodies. It is pertinent to ask why the presidents of the United States have not, at least within recent years, seen it possible to give us even tolerably good governors. The explanation lies, of course, in the so-called policy of home rule, which in this case results in practically giving the appointment of the chief executive into the hands of the then dominant predatory organization. It would seem more logical either to make us a state and let us make our own muddle, or treat us as a child-commonwealth and provide us with competent rulers.

The New Mexico Normal University, which opened its doors five years ago, has had until now a most fortunate immunity from political interference. In spite of its rather ridiculous name, it has prospered under the guidance of men who understood its proper aims and needs. This has been principally due to the wisdom and influence of Mr. Frank Springer, the well-known authority on crinoids, who has been president of the board of regents. Mr. E. L. Hewett, the president of the school, is a well-

known educator and student of anthropology. The faculty has been chosen by the president, and elected to serve indefinitely on good behavior, instead of being reelected annually as at the Agricultural College. In so young a school much remained for the future, but progress has been steady and satisfactory, and the institution was beginning to amount to something as a scientific center.

All this is now to be changed. All along there had been attempts within and without the board of regents to effect undesirable changes, but so far it had been possible to suppress them, and the faculty usually heard nothing of them. However, when a member of the board recently resigned because he was leaving New Mexico, Governor Otero appointed for the unexpired term a man who was well known to be hostile to the existing management. After a time it became plain that a destructive policy was intended, and Mr. Springer resigned from the board. The faculty held a meeting to discuss the situation, and sent one of their number to represent the facts to Governor Otero. The governor, however, offered no relief and plainly intimated that if we resigned there were plenty more where we came from. It was then decided to lay the matter before the public, and a printed pamphlet was issued, setting forth the conditions in detail. This was well received by the public and the students, the great majority siding with the faculty; the students especially being practically unanimous, and passing resolutions expressing their opinions. The City Council of Las Vegas also passed resolutions in favor of the faculty. In the face of all this, however, Governor Otero reappointed the regent objected to for a full term, and appointed in Mr. Springer's place one of the regular politicians. In these actions he was supported by the council of the recent New Mexico legislature, which has been exceptionally corrupt and incompetent. Hence the faculty goes.

T. D. A. COCKERELL.

LAS VEGAS, N. M.,
April 12, 1903.

SHORTER ARTICLES.

THE USE OF PNEUMATIC TOOLS IN THE PREPARATION OF FOSSILS.

THE tedious work of removing fossils from their matrix by means of the hammer, chisel and awl has led to various experimentation with machine tools in the hope of devising some more rapid method. The dental engine and the electric mallet have been in use in some laboratories for a number of years, and have proved very efficient in such work as the removal of hard matrix from small skulls. However, their efficiency has so far been limited to light work. This is probably due in a large part to the fact that the tools used are those constructed for the lighter work of dentistry. It is also generally conceded that electric appliances have not proved a success in percussion tools.

Pneumatic tools were introduced into the paleontological laboratory at the Field Columbian Museum by the writer some four months ago, and may now be said to have passed through the experimental stage. The application of these tools to fossil-cleaning has proved so successful that it has seemed worth while to call attention to their use in this work.

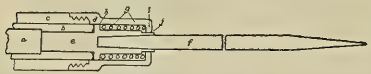
The pneumatic hammer as used in chipping and riveting metals and in stone-cutting is too well known to require description here. However, only the lightest hammers used in stone-cutting come within range of our present consideration. These are manufactured by a number of firms in the United States and are of two types, the pistol-grip and the straight cylinder. The latter type has been adopted by the writer on account of greater convenience in bringing the tool into use in work in all positions. Experimentation has shown that the smallest hammers on the market as stone working tools are heavy enough for any work on fossils. A still smaller size would often be convenient.

The hammer in use consists of a cylindrical chamber in which a five-eighth-inch steel plunger having a five-eighth-inch stroke is caused to play upon the head of the chisel at the rate of 3,000 to 3,500 strokes per minute.

This rapid succession of light blows sets up a vibration in the chisel, which, with even a slight pressure against the work, gives it a remarkable cutting capacity. In fact a chisel so driven will cut an indurated clay as rapidly as an ordinary hand tool will cut chalk.

The chisels commonly used in stone cutting are made uniformly of one-half-inch square or octagon steel about nine inches in length. Of these one and one half inches of the head end is turned down to three-eighth-inch diameter, so as to fit into the chamber of the tool and provide the shoulder necessary to hold the chisel at the precise point which will render the stroke of the hammer most effectual. These chisels are used indiscriminately in all sizes of stone hammers and are ill adapted for the preparation of fossils. The requisite for such delicate work is a keen stroke under complete control. This has been in a measure attained by fitting an attachment to the stone cutting hammer.

In the accompanying figure *a* represents the plunger, *b* the hard steel barrel and *c* the softer outer jacket of the hammer. A tempered steel cylinder *d* is attached to *c* by a heavy thread; this holds in position a separate tool head *e*, which receives the blow of the hammer and bears the chisel *f* in a taper socket. A coil spring *g* acting against the shoulders *h* and *i* in turn receives the blow of the hammer or any part of it not util-



Cross-section of Pneumatic Hammer, with Tool-holding attachment.

ized in work at the point of the chisel. The tool head *e* is fitted to a square opening in *d* at *j* which prevents rotation. The taper-socket holds the chisel in place so that it may be guided by the hammer; when desired the chisel may be readily released by placing in a vise and tapping the tool head lightly. One escape-vent is directed forward so as to blow away dust and small chips from the work. For chisels, one-fourth-inch round steel cut in six-inch lengths and drawn to a point of one-eighth or three-sixteenth inch in breadth are most efficient. For finishing, a broader bladed chisel may be used to advantage.

This appliance makes it possible to dispense with the unnecessary weight of metal in the chisel so that a keener stroke and a greater cutting capacity result. At the same time the manipulator is relieved of the necessity of holding the chisel in place with the left hand and so avoids the benumbing jar caused by the vibration.

The advantages of this hammer over the old-fashioned hammer and chisel are its much greater cutting capacity and its freedom from the jar which causes so much breakage in specimens encased in hard matrix. The relative cutting capacity depends upon the nature of the material to be removed. If it be sandstone, by which tools are rapidly dulled, blocking off in large pieces by means of hammer and chisel will be found more expedient. Or if it be a very hard substance, such as quartz or chalcedony infiltrations, a method of spalling by means of a square-poled hammer may prove more efficient than either. But in limestone or any of the indurated clays the superiority of the pneumatic hammer is at once evident. This is especially true in the case of complicated specimens where there are deep cavities or foramina to be developed. In such work the pneumatic chisel can be used wherever its point can be introduced, while with the old-fashioned hammer and chisel one is often at a loss for room to hold and strike. The cutting capacity of a chisel is much greater also when used with the pneumatic hammer, as the point can be made much harder without danger of breaking. Chisels made from a high grade English steel of 1.4 per cent. carbon chilled to a file-like hardness may be used four or five hours in concretionary clays without need of grinding.

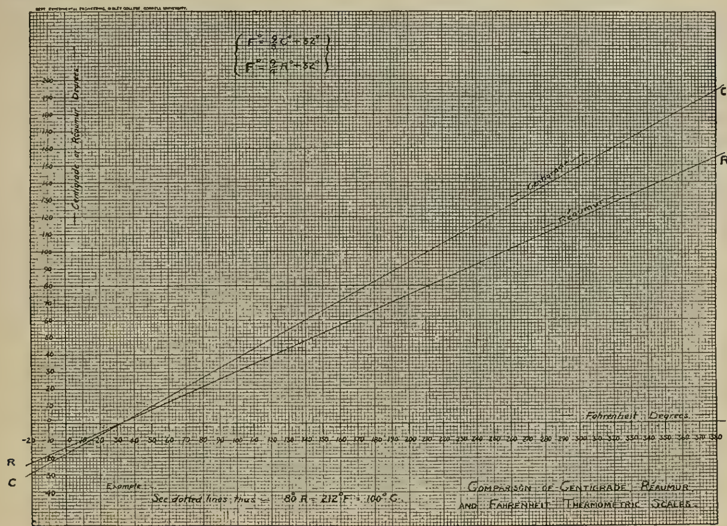
The advantage of relieving the specimen from the jar of the hand-hammer can scarcely be overestimated. In working out dinosaur vertebræ from a concretionary matrix by means of hand tools we have often found it necessary to break the specimen to pieces with a hammer in order to remove the chalcedony-filled masses of concretion from the

cavities. The use of the pneumatic chisel has made it possible to remove the matrix from such cavities, with but little injury to the specimen. The tendency to chip off thin edges with flakes of the matrix is also avoided.

Skill in the use of these tools is readily acquired. By adapting the size of the chisel to the work in hand and gauging the amount of air admitted to the tool by means of a push-button throttle valve, the stroke can be reduced so that a scale may be removed from the most delicate surface.

E. S. RIGGS.

FIELD COLUMBIAN MUSEUM.



THERMOMETRIC READINGS.

HAVING had frequently occasion to transfer thermometric readings given in one of the common systems, Centigrade, Fahrenheit and Réaumur, into one of the others, the accompanying diagram has been developed, which affords a convenient and rapid means of such transformation, and is adequate, provided a high degree of accuracy is not desired. The relations between the three systems are given by the following formulæ:

$$F.^\circ = \tfrac{9}{5}\,C.^\circ + 32^\circ = \tfrac{9}{4}\,R.^\circ + 32^\circ.$$

Fahrenheit degrees being plotted along a horizontal axis, and Centigrade or Réaumur degrees along a vertical axis, the graphs of the two equations above give two straight lines, as shown, from which, having given a reading in one of the systems, the corresponding reading in either one of the other two may be obtained.

Thus to find the equivalent of 80° R. the horizontal from the 80° division on the vertical axis is followed to its intersection with the line marked Réaumur, thence downward where the corresponding Fahrenheit reading (212° F.) is found on the horizontal axis; or upward to 'Centigrade' line and thence horizontally to left where the corresponding Centigrade reading (100° C.) is found on the vertical axis.

Both lines cross the horizontal, or Fahrenheit, axis at the same point, 32°; the Réaumur

line having a slope of $\frac{9}{4}$, the Centigrade line a slope of $\frac{9}{5}$.

The diagram is capable of being extended as far as may be desired, and by shifting the origin of coordinates and choosing a suitable scale of magnification, almost any desired degree of accuracy may be obtained for readings along any given part of the diagram.

S. W. DUDLEY.

SHEFFIELD SCIENTIFIC SCHOOL,
YALE UNIVERSITY,
February 7, 1903.

DISCOVERY OF DENTAL GROOVES AND TEETH IN THE TYPE OF BAPTANODON (SAURANODON) MARSH.

THROUGH the courtesy of Dr. C. E. Beecher the writer has recently enjoyed the privilege of studying the types in the Yale Museum on which Professor O. C. Marsh based the description of *Baptanodon natans* and *B. discus*.

The discovery * of teeth in the jaws of an Ichthyosaurian (No. 603) belonging to the collection of fossil vertebrates of the Carnegie Museum, led the author to believe that dental grooves, if not teeth, were present in the type of the genus *Baptanodon*.

Only a little preparation was necessary to demonstrate the existence of well-developed dental grooves on both upper and lower jaws, and just outside of the dental groove, imbedded in the matrix surrounding the rostrum of No. 1952† (type of the genus), a small tooth was discovered. This tooth is Ichthyosaurian in character. The enameled crown, however, is perfectly smooth, there being present no such longitudinal striæ as those observed on the teeth belonging to No. 603 of the Carnegie Museum. The complete preparation of No. 1952 would undoubtedly reveal other teeth. Professor Marsh's statement, that 'the jaws appear entirely edentulous and destitute even of a dentary groove,' was doubtless due to the imperfectly prepared material upon which he based his first description.

* 'Discovery of Teeth in Baptanodon, an Ichthyosaurian from the Jurassic of Wyoming,' SCIENCE, N. S., Vol. XVI., No. 414, December 5, 1902, pp. 913–914.

† Catalogue number of the Yale Museum.

The presence of teeth in the type of *Baptanodon*, as well as their existence in two specimens preserved in the collections of this museum, clearly demonstrates the fact that American Ichthyopterygians possessed teeth. This fact, now firmly established, makes it still more difficult to separate the genus *Baptanodon* from the closely allied European form *Ophthalmosaurus*, and unless other distinguishing characters can be found they will necessarily have to be considered as generically identical. *Baptanodon* would then become a synonym of *Ophthalmosaurus*.

In my first paper I provisionally proposed the new genus *Microdontosaurus*, using as the type No. 603 of the Carnegie Museum collections. I then distinguished this genus from *Baptanodon* by the supposedly edentulous character of the latter. Since, however, *Baptanodon* has been conclusively demonstrated to have possessed teeth *Microdontosaurus* must be abandoned as a synonym of *Baptanodon* or *Ophthalmosaurus*.

Since some time must necessarily elapse before the publication of the final paper upon which the writer is now engaged, it has been thought best to call attention to the discovery of teeth in the type of the genus *Baptanodon*, which has been considered edentulous for nearly a quarter of a century.

CHARLES W. GILMORE.

CARNEGIE MUSEUM,
April 4, 1903.

THE BITTER-ROT FUNGUS.

IN 1854 Berkeley (*Gardener's Chronicle*, p. 676) described a fungus, *Septoria rufomaculans* n. sp., growing on grapes. He renamed this in 1860 ('Outlines of British Fungology,' p. 320), calling it *Ascochyta rufomaculans* Berk. In 1879 von Thümen ('Fungi Pomicoli,' p. 59) placed this fungus in the genus *Glœosporium* and it then became *Glœosporium rufomaculans* (Berk.) von Thümen. In 1856 Berkeley (*Gardener's Chronicle*, p. 245) described a fungus causing a rot of apples, naming it *Glœosporium fructigenum* n. sp. This is the fungus which is the cause of the bitter-rot disease of apples which has caused such extensive damage to apple crops for many

years. It has now been shown that the *Glœosporium* on grape and the *Glœosporium* on apple are one and the same fungus, and this fungus has by common consent been called *Glœosporium fructigenum* Berk. In 1902 Clinton ('Bulletin Illinois Agricultural Experiment Station,' 69:193–211, III.) described the perfect stage of this fungus and placed it in the genus *Gnomoniopsis* established by Miss Stoneman (*Botanical Gazette,* 26:71–74, 99–101, 113–114) in 1898, making the name for the bitter-rot fungus *Gnomoniopsis fructigena* (Berk.) Clinton. Recent studies have shown that the name *Gnomoniopsis* applied to the perfect forms of several species of *Glœosporium* and *Colletotrichum* by Miss Stoneman in 1898 was used by Berlese in 1892 ('Icones Fungorum,' p. 93) for a very different group of fungi. The genus name *Gnomoniopsis* Stoneman is, therefore, invalidated, and a new name must be given to the fungi included until now under that name. The writers propose the name *Glomerella,* in which the following species can up to the present time be included:

Glomerella cingulata (Atk.) Spaulding & v. Schrenk.

Glomerella piperatum (E. & E.) Spaulding & v. Schrenk.

Glomerella cinctum (B. & C.) Spaulding & v. Schrenk.

Glomerella rubicolum (E. & E.) Spaulding & v. Schrenk.

To the above the bitter-rot fungus must be added. As the name *Glœosporium rufomaculans* and *Glœosporium fructigenum* apply to the same fungus, and as *Glœosporium rufomaculans* antedates *Glœosporium fructigenum* the new name for the bitter-rot fungus becomes *Glomerella rufomaculans* (Berk.) Spaulding & von Schrenk, with the following synonyms:

Glomerella rufomaculans (Berk.) Spaulding & von Schrenk.

Septoria rufomaculans (Berk.) 1854.

Ascochyta rufomaculans (Berk.) 1860.

Glœosporium rufomaculans (Berk.) von Thümen, 1879.

Glœosporium fructigenum (Berk.) 1856.

Glœosporium læticolor (Berk.) 1859.

Glœosporium versicolor (Berk. & Curt.) 1874.

Gnomoniopsis fructigena (Berk.) Clinton, 1902.

HERMANN VON SCHRENK,
PERLEY SPAULDING.
U. S. DEPT. OF AGRICULTURE.
MISSOURI BOTANICAL GARDEN.

QUOTATIONS.

THE INDEX MEDICUS.

WE are informed on good authority that the 'Index Medicus,' the first number of which under the new auspices has just appeared, is not receiving its due support, that 251 copies cover the entire subscription list among the profession, both abroad and in this country. That would bring in a return of only $1,255, with an expenditure of about $12,000 per annum. The Carnegie Institution has generously devoted $10,000 per annum to the publication of the index for three years and it was intended to continue this indefinitely, provided sufficient interest is shown in this enterprise, which has in the past redounded so much to the credit of our country. The 'Index Medicus' should go to every place where at least an attempt at clinical or research work is being done, to every insane asylum, to every large hospital, to every medical educational institution, and, in our opinion, it is almost an indispensable adjunct to the editorial work of every medical journal worthy of the name. If it can receive subscriptions from each of these sources, it would not only relieve the Carnegie Institution of its expense, but furnish a considerable surplus for its enlargement and increased usefulness. It is not an American publication alone. It should receive equal patronage from every part of the world. It is just as discreditable, if not more so, that its subscription list from abroad is not more than double or treble what it is in this country. No person who is interested in medical literature, no one who is attempting to do original work, can wilfully dispense with the aids it can offer. The fault of much of the work that has been done and is still being done throughout the world, especially in some of the insti-

tutions in this country, is that so little is known of what others are doing and, consequently, a great deal of human effort is needlessly wasted. Much sciolistic conceit would be also avoided if this publication, with its preceding series and additional data from the 'Index Catalogue,' could be properly utilized, and medical literature would be a far more satisfactory thing than it is at present. Brown-Sequard, the celebrated French physiologist, used to bitterly complain of the amount of rediscovery of his work that he was constantly seeing in the German literature. It is only by such bibliographies as the 'Index Medicus' that much of this can be avoided. We hope the subscription list will be at least quadrupled. The very moderate subscription price, $5, puts it within the reach of everyone who is attempting to do any medical literary work, and no one should attempt that without having at least access to its aid. We do not believe in multiplication of references or unnecessarily elaborate bibliographies, and the rule of verifying one's references by the originals, of course, is a good one to be followed, but there is no better first guide to medical literature than the 'Index Medicus' as now presented to the profession.—*Journal of the American Medical Association.*

THE PRESIDENCY AT THE UNIVERSITY OF VIRGINIA.

The University of Virginia, after adhering for over eighty years to the plan of government devised by its founder, Thomas Jefferson, now decides to conform to the practice of other American universities and to elect a president. From the names suggested for the office it may be inferred that it is a 'business' president that is wanted. No doubt, the trustees of the university know best the needs of the institution, and it may be that in the modern competition in education it is necessary to sacrifice individual characteristics. An enlightened despotism, more or less tempered by trustee or overseer supervision, can accomplish much in a short time from both the financial and the educational points of view, as Harvard shows. It is possible, therefore, that the change may bring immediate prosperity to the University of Virginia.

All the same, regret must be felt that a system devised by the great Democrat with the deliberate purpose of eliminating the one-man power, a system that has proved efficient and successful in its scholarly results and in the character of the men trained under it, should disappear in the modern craving for uniformity and for quick material gains.—New York *Sun.*

CURRENT NOTES ON METEOROLOGY.

GENERAL CIRCULATION OF THE ATMOSPHERE.

An important publication is the report on the general circulation of the atmosphere, prepared by Dr. Hildebrandsson as Part I. of the 'Rapport sur les Observations internationales des Nuages' for the International Meteorological Committee (Upsala, 1903, large 8vo., pp. 48, pls. XXII.). This is a brief historical presentation of the theories of the general circulation of the atmosphere advanced by Dove, Maury, Ferrel and Thomson, and an examination of the results of cloud observations made at stations in different parts of the world in their bearing on these theories. These results, which include the latest and best obtainable, are presented graphically in a series of twenty-two charts, for stations selected because of their position in certain critical latitudes. Thus, among these stations are found the following: San José de Costa Rica; 'Square No. 3' (Lat. 0°–10° N.; Long. 20°–30° W.); Manila; Mauritius; San Fernando and Lisbon; Havana; Lahore, Allahabad and Calcutta; Kurrachee, Bombay and Cuttack; Blue Hill; Paris; several in England, Germany and Denmark; Upsala, and others in Sweden, Norway, Siberia, China, Japan. Dr. Hildebrandsson, as is well known, has already done most important work in his study of cloud forms and cloud measurements, and he has been one of the moving spirits in the international investigation of cloud heights and velocities. He is, therefore, the meteorologist who is perhaps best fitted to undertake the discussion in hand, and his conclusions, which are based on a thorough study of data carefully compared and digested, will be received with satisfaction and accepted with confidence. So important are some of these conclusions in their bearing on

the theory of the general circulation of the atmosphere as put forward by Ferrel and Thomson, and as adopted in all the newer textbooks, that it seems well to give here a translation of Dr. Hildebrandsson's summary (pp. 47–48 of the report):

"By means of direct observations the following results have been obtained: (1) Above the heat equator and the equatorial calms there is, throughout the year, a current from the east which seems to have very high velocities at great altitudes. (2) Above the trades there is an anti-trade from S. W. in the northern, and from N. W. in the southern hemisphere. (3) This anti-trade does not extend beyond the polar limit of the trade; it is deflected more and more to the right in the northern, and more and more to the left in the southern hemisphere, and finally becomes a current from the west above the crest of the tropical high pressure belts, where it descends to supply the trades. (4) The districts at the equatorial margin of the trades are partly in the trades and partly in the equatorial calms, according to the season. Above them there is, therefore, an upper monsoon: the anti-trade in winter, and the equatorial current from the east in summer. (5) From the tropical high pressure belts the air pressure on the whole decreases continuously towards the poles, at least to beyond the polar circles. Further, the air of the temperate zone is drawn into a vast 'polar whirl' turning from west to east. This whirling movement seems to be of the same nature as that in an ordinary cyclone: the air of the lower strata approaches the center, while that of the higher strata tends out from the center, and this outward tendency increases with the altitude above sea level as far up as the greatest altitudes from which we have observations. (6) The upper currents of the atmosphere in the temperate zones extend over the tropical high pressure belts, and descend there. (7) The irregularities which are noted at the earth's surface, especially in the regions of the Asian monsoons, as a whole disappear at the lower or intermediate cloud levels. (8) We must entirely abandon the notion of a vertical circulation between tropics and poles which has up to this time been accepted in accordance with the theories of Ferrel and Thomson."

This 'vertical circulation,' to which allusion is made, refers to the view that the air, ascending near the equator, flows as an upper current across the tropical high pressure belts to the circumpolar regions, and thence returns as an intermediate current from the poles towards the equator. It is in regard to this point that the conclusions of Dr. Hildebrandsson are most interesting. Dr. Hildebrandsson expressly states that he simply presents facts, and does not discuss theories. But he does say most emphatically (p. 44): *"Il faut donc abandonner une fois pour toutes cette idée d'une circulation verticale entre les tropiques et les poles,*—circulation qui semble du reste impossible pratiquement dans une couche dont l'épaisseur est très petite en comparison avec les distances horizontales. Espérons que dès à présent ces 'courants polaires' et 'équatoriaux,' qui ont fait tant de confusion dans la météorologie dynamique, disparaîtront enfin complètement de la science météorologique, au moins dans le sens dans lequel on les a adoptés jusqu'ici."

R. DEC. WARD.

THE LIGHT OF NOVA GEMMORUM.

THE light of Nova Gemmorum appears to be fluctuating like that of Nova Persei No. 2. On the evening of May 1 it appeared that its light had increased about half a magnitude during the preceding twenty-four hours. Since the measures described in the *Astronomical Bulletin* of April 22, similar measures were obtained on April 24, 25, 27, 28, 29, 30 and May 1, and gave the magnitudes 9.37, 9.67, 9.71, 9.81, 9.61, 9.76 and 9.26 respectively.

EDWARD C. PICKERING.

BRAIN-WEIGHT, CRANIAL CAPACITY AND THE FORM OF THE HEAD, AND THEIR RELATIONS TO THE MENTAL POWERS OF MAN.

DR. H. MATIEGKA, in Part I. of his extensive studies on this subject,* has published some

* 'Ueber das Hirngewicht, die Schädelkapacität und die Kopfform, sowie deren Beziehungen zur psychischen Thätigkeit des Menschen,' *Sitzb. d. kön böhm. Ges. d. Wiss.*, II. Classe, Article XX., 1902.

new and interesting facts concerning the weight of the human brain. His material and data were gathered in the Bohemian Institute of Pathological Anatomy and in the Institute of Forensic Medicine, and were subjected to a careful analysis with reference to age, sex, stature, race, muscular and skeletal development, state of nutrition, mental state, occupation, cranial capacity and form, and the mode of death. The work is exhaustive, and hardly permits of suitable abstraction in a limited space. Only a few of the most interesting results may be quoted here.

The heaviest male brain (1,820 gms.) was that of a young man, age 22, of large stature (180 cm.) and powerful build, well-nourished; suicide by drowning. The heaviest female brains, three in number, weighed 1,500 gms. The lightest female brain, from an individual of middle age (25 years), weighed 1,020 gms., with a stature of 150 cm.; cause of death, hemorrhage from a stab-wound of the lung. The brain of a senile female (age, 89) weighed 1,000 gms. The average weight (or as Matiegka specifies, '*der Kulminationspunkt*') of males aged 20 to 59 is 1,400 gms.; of females, 1,200 gms.

Among recent brain-weights of notable persons, Matiegka mentions that of Konstantinoff, a Bulgarian novelist, 1,595 gms.; F. Smetana, the insane composer, 1,250 gms. (atrophy of paralytic dementia); J. G. Kolár, a Bohemian dramatic writer, 1,300 gms. (age, 84 years; senile atrophy), and Marie Bittner, a talented actress, age 44, 1,250 gms. (about 45 gms. above the average). The skull of P. J. Šavařík, the noted Slavist, had a capacity of 1,738 c.c., which, with Manouvrier's coefficient 0.87, gives an estimated brain-weight of 1,512 gms.

One of the most interesting chapters in Matiegka's monograph concerns the relations of brain-weight and occupation. For this analysis he had 235 brain-weights at his disposal, which he arranged in six groups, ascending from the ordinary day-laborers, who never could learn a trade or remain steadily employed, to those of considerable mental ability. The table is here reproduced in condensed form:

	No. of Cases.	Average Brain-weight.
Group I. Day-laborers	14	1,410.0
" II. Laborers	34	1,433.5
" III. Porters, watchmen, etc.	14	1,435.7
" IV. Mechanics, trades-workers, etc.	123	1,449.6
" V. Business-men, teachers, clerks, professional musicians, photographers, etc.	28	1,468.5
" VI. Men of higher mental abilities, presupposing a collegiate education, such as scholars, physicians, etc.	22	1,500.0

Persons employed in clothing industries, who are apt to be poorly nourished and not very muscular, show a lower brain-weight, 1,433.6 gms. Carpenters (11 cases) have 1,441.8 gms.; coachmen and truck-drivers (14 cases), 1,445.7 gms. Blacksmiths, locksmiths and metal-workers in general, who are as a rule muscular and well-nourished, have a higher brain-weight (21 cases). 1,476.7 gms. Persons occupied in the manufacture and sale of alcoholic beverages (brewers, tavern-keepers, waiters, etc.) have a low brain-weight (16 cases), 1,416.9 gms., doubtlessly due to the large proportion of drinkers among them.

These results are indeed striking and significant, and while they may be challenged as being based upon an insufficient number of cases, the method of the analysis employed by Matiegka is worthy of wide-spread adoption in anatomical institutes everywhere.

E. A. Spitzka.

THE ST. LOUIS CONGRESS OF ARTS AND SCIENCES.

We begin on Monday, the 19th of September, 1904, late enough to avoid the tropical summer heat of St. Louis, and early enough still to make use of the university vacations. On Monday morning the subject for the whole congress is knowledge as a whole, and its marking off into theoretical and practical knowledge. Monday afternoon the seven divisions meet in seven different halls; Tuesday the seven divisional groups divide them-

selves into the twenty-five departments, of which the sixteen theoretical ones meet in sixteen different halls on Tuesday morning, and the nine practical, on Tuesday afternoon. In the following four days the departments are split up into the sections; the seventy-one theoretical sections meeting on Wednesday, Thursday, Friday, Saturday, about eighteen each morning in eighteen halls, and the fifty-nine practical sections on the same days in the afternoons, the arrangement being so made that sections of the same department meet as far as possible on different days, every one thus being able to attend in the last four days of the first week the meetings of eight different sections, four theoretical and four practical ones, in the narrower circle of his interests. In the second week a free sub-division of the sections is expected, and, moreover, a number of important independent congresses, as, for instance, an international medical congress, an international legal congress, and others, are foreseen for the following days. These independent congresses will highly profit from the presence of all the leading American and foreign scholars, whose coming to St. Louis will be secured by the liberal arrangements of the official congress in the first week; on the other hand, these free congresses represent indeed the logical continuation of the set work of the first seven days, as they most clearly indicate the further branching out of our official sections, leading over to the specialized work of the individual scholars. And yet this second week's work must be, as viewed from the standpoint of our official congress, an external addition, inasmuch as its papers and discussions will be free independent contributions not included in the one complete plan of the first week, in which every paper will correspond to a definite request. The official congress will thus come to an end with the first week, and we shall indicate it by putting the last section of the last department, a section on religious influence in civilization, on Sunday morning, when it will not be, like all the others on the foregoing days, in competition with fifteen other sections, and may thus again combine the widest interests. In this section there will be room also for the closing exercises of the official occasion.

The arrangement of the sciences in days and halls is however merely an external aspect. We must finally ask for the definite content. Our purpose was to bring out the unity of all this scattered scientific work of our time, to make living in the world the consciousness of inner unity in the specialized work of the millions spread over the globe. The purpose was not to do over again what is daily done in the regular work at home. We desired an hour of repose, an introspective thought, a holiday sentiment, to give new strength and courage, and, above all, new dignity to the plodding toil of the scientist. Superficial repetitions for popular information in the Chautauqua style and specialistic contributions like the papers in the issues of the latest scientific magazines would be thus alike unfit for our task. The topics which we need must be those which bring out the interrelation of the sciences as parts of the whole; the organic development out of the past; the necessary tendencies of to-day; the different aspects of the common conceptions; and the result is the following plan:

We start with the three introductory addresses on 'Scientific Work,' on the 'Unity of Theoretical Knowledge,' and on the 'Unity of Practical Knowledge,' delivered by the president and the two vice-presidents. After that the real work of the congress begins with a branching out of the seven divisions. In each one of them the topic is fundamental conceptions. Then we resolve ourselves into the twenty-five departments, and in each one the same two leading addresses will be delivered; one on the development of the department during the last hundred years, and one on its methods. From here the twenty-five departments pass to their sectional work, and in each of the one hundred and thirty sections again two set addresses will be provided; one on the relations of the section to the other sciences, one on the problems of to-day; and only from here does the work move during the second week into the usual channels of special discussions. We have thus during the

first week a system of two hundred and sixty sectional, fifty departmental, seven divisional, three congressional addresses which belong internally together, and are merely parts of the one great thought which the world needs, the unity of knowledge.—Professor Hugo Münsterburg in the *Atlantic Monthly*.

SCIENTIFIC NOTES AND NEWS.

During the week beginning June first, Professor J. J. Thomson, F.R.S., Cavendish professor of experimental physics in the University of Cambridge, will give a course of lectures in the Physical Laboratory of the Johns Hopkins University on 'A Theory of the Arc and Spark Discharges.'

Professor Klement Arkadijevic Timirjazev, professor of botany at Moscow, gave the Croonian lecture before the Royal Society on April 30, his subject being 'The Cosmical Function of the Green Plant.'

The University of Glasgow has conferred the degree of Doctor of Laws on Sir Norman Lockyer, director of the Solar Physics Observatory, South Kensington, and editor of *Nature;* Dr. Thomas Oliver, professor of physiology in the University of Durham, and Mr. Philip Watts, director of naval construction at the Admiralty.

The University of Dublin has conferred the degree of Doctor of Science on Sir William Abney, F.R.S., assistant secretary of the British Board of Education, known for his work on photography and color vision.

We learn from *Nature* that M. Lippmann is to succeed M. Poincaré as president of the French Astronomical Society this month. M. Janssen has been elected *president d'honneur*. The society's prize has been awarded to M. Charlois for the discovery of a large number of minor planets, and the Janssen prize to M. Giacobini for the discovery of seven comets.

Professor Ralph W. Tower, of Brown University, associate professor of chemical physiology, has been elected head of the department of physiology and curator of the books and publications in the American Museum of Natural History in New York City.

Mr. Sidney D. Townley has been placed in charge of the International Latitude Observatory at Ukiah, Cal.

Mr. Hugh H. Bennett, assistant in the Chemical Laboratory, University of North Carolina, has accepted the position of assistant in the Chemical Laboratory, Division of Soils, U. S. Department of Agriculture.

Dr. Capitan has been made a member of the committee on historic and scientific works of the French ministry of public instruction, in room of the late M. Bertrand.

Mr. F. A. Delano, general manager of the C. B. and Q. R. R., gave an address before the engineering students of Purdue University upon 'The Comparative Development of American and European Railways,' on April 13.

Drs. William H. Welch and William Osler gave a dinner at the Maryland Club, April 18, to Dr. Robert Fletcher, of Washington, editor of the 'Index Medicus,' to celebrate the revival of its publication.

Mr. H. F. Perkins, of the University of Vermont, has been given a research assistantship by the Carnegie Institution for study of special organs and structure of jelly-fish which affect their distribution.

Professor Charles S. Sargent, director of the Arnold Aboretum, Harvard University, will spend next year abroad, devoting a part of the time to studying the trees of Siberia.

Dr. W. A. Setchell, professor of botany in the University of California, has been given a year's leave of absence which he will spend in Europe.

M. E. Jaffa, assistant professor of agriculture in the University of California, who has for the present year been carrying on studies in nutrition in conjunction with Professor W. O. Atwater, has gone to Europe to visit the centers where similar work is in progress.

The National Geographic Society has appointed Mr. William J. Peters, of the U. S. Geological Survey, as its representative on the Arctic expedition to be sent by Mr. William Ziegler. Mr. Peters will be second in com-

mand of the expedition, as well as director of the scientific observations.

The Russian Geographical Society will send a scientific expedition into Mesopotamia during the year. The expedition will be under the leadership of M. Kaznakoff, and will include among its members M. Alferaki, the zoologist, and M. Tolmatcheff, the geologist.

M. Lacroix, sent by the Paris Academy of Sciences to Martinique, has returned to Paris, after six months spent in studying the conditions on the island.

Mr. Jonathan Hutchinson has returned from India, where he has been investigating the cause of leprosy.

A window in honor of Horace Wells, the discoverer of anesthesia, has been placed in the First Congregational Church at Hartford, Conn., by his son, Mr. Charles T. Wells. The cartoon was designed by Mr. Frederick Wilson and executed by the Tiffany Company, New York City.

Paul Belloni Du Chaillu, the explorer and author, died at St. Petersburg on April 29. He was born in New Orleans in 1838, and in 1855 he went from New York to the west coast of Africa, where he made the well-known expedition described in his 'Explorations and Adventures in Equatorial Africa.'

The death is announced of M. E. Duporcq, secretary of the French Mathematical Society, at the age of thirty-one years.

The American Medical Association is meeting this week at New Orleans under the presidency of Dr. Frank Billings.

The American Social Science Association meets in Boston on May 14, 15 and 16. Sessions are to be devoted to the discussion of public health and education in physiology and hygiene, the speakers including Professor W. T. Sedgwick, Dr. W. T. Councilman and Dr. E. M. Hartwell.

The Medical Record and *The Medical News* publish cable reports of the fourteenth international Medical Congress, which met at Madrid last week. On the first day five thousand delegates were registered, proportioned as follows: Germany and Austria, 1,000; France, 825; Great Britain, 235; Russia, 290; Italy, 335; other European countries, 327; United States, 193; South America, 136. The Moscow prize for original research, established by the city of Moscow, in honor of the meeting of the Congress in that city in 1897, was awarded to Professor Metchnikoff, and that of Paris to Professor Grassi. It is expected that the next congress will be at Buda Pesth. No discoveries of an epoch-making character appear to have been presented to the congress, though the programs are said to contain the titles of many papers of importance.

The Boston *Transcript* states that a bill has been favorably reported to the Connecticut General Assembly providing for the establishment of a geological and natural history survey of the State. The work is to be conducted under a commission composed of the governor, the presidents of Yale and Wesleyan Universities, of Trinity College and of the Connecticut Agricultural College. The commission is to serve without compensation except for necessary expenses. It is directed to appoint as superintendent of the survey a scientist of established reputation and such assistants as may be deemed necessary. The bill carries an appropriation of $3,000. The objects of the survey as explained in the bill are as follows: First, an examination of the geological formations of the State with special reference to their economic products, namely, building stones, clays, ores and other mineral substances; second, an examination of the animal and plant life of the State with special reference to its economic and educational value; third, the preparation of special maps to illustrate the resources of the State; and fourth, the preparation of special reports, with necessary illustrations and maps, which shall embrace both a general and a detailed description of the geology and natural history of the State. It is expected that the bill will pass without opposition.

Nature states that the French Physical Society has held its annual exhibition of apparatus in Paris. The entrance hall and vestibule were lighted with 'heliophone' lamps of the French Incandescent Gas Company, the stair-

case and ground floor by the French Oxyhydrogen Company, and the entrance hall of the first floor by Nernst lamps. Conferences were held in the Physics Theatre of the Faculty of Sciences on April 16, 17 and 18, at which the following papers were read:—'On Anomalous Propagation of the Form of Vibrations in the Neighborhood of a Focus,' by M. G. Sagnac; 'Recent Researches in Radioactivity,' by M. P. Curie; 'Experiments on Electric Convection,' by MM. Crémieu and Pender; and 'Further Experiments on Electric Convection,' by M. Vasilesco Karpen.

Reuter's Agency states that Sir Alfred Jones, chairman of the Liverpool School of Tropical Medicine, has received the following communication from the expedition sent by the school to the Gambia and Senegambia to investigate the newly-discovered parasite of trypanasoma. The report is dated March 18, and comes from McCarthy Island, 150 miles in the interior of the Gambia. The communication says: "We have just returned from a trip, taking nearly two weeks, to Maka, the chief town of the French 'Cercle de Niani-Ouli.' While there we stayed with M. Porthes, the French Commandant of that district, who was very kind to us in every way. Maka is situated about sixteen miles from the head of Kunchau creek, and about twice that distance from the main river. Our object in going there was to examine the natives living in the interior and away from large collections of water. Although we found the parasite in none of the natives examined, we did find a trypanasome in each of two horses belonging to the Commandant, which he believes to have become infected while in the district far up the river beyond the British possessions. We are hoping that there is something in this, and intend to experiment at St. Louis (French territory), as many horses there are said to suffer from a species of 'malaria,' and die from it. We hope to be able to show that it is trypanasoma, the symptoms, as far as we can see at present, being the same as those developed in the two horses seen at Maka. This will be of great importance to the French government in Senegal if correct. If it is at all possible, Dr. Todd intends leaving for this district within the next two days. At present we intend to leave the Gambia by the *Benin*, which is due at Bathurst on the 7th of next month. From Dakar we shall go straight to St. Louis, where, unless something important turns up, we shall only stay for a fortnight before returning to Dakar to catch the steamer for Conakry. We recently infected a horse with the human trypanasome. Only two days ago we found numerous trypanasomes in its blood, and in the stomach of a species of horn fly (which is rather troublesome here) which had fed on this horse we found interesting forms of the parasites suggesting conjugation."

At the recent meeting of the Michigan Academy of Science, at Ann Arbor, the two following resolutions were adopted:

(1) Whereas, The contour topographic map of the Ann Arbor quadrangle, recently completed by the United States Geographical Survey in cooperation with the Geological Survey of Michigan, is of a high degree of excellence; and

Whereas, A similar map of the entire area of Michigan, in addition to its direct commercial and educational importance, would be of great assistance in many branches of scientific research:

Resolved, That the request now before the legislature for an addition of $1,000 to the appropriation for the State Geological Survey, to enable it to continue to cooperate with the United States Geological Survey in making a topographical survey and contour topographic map of Michigan, is heartily approved, and the prompt passage of the measure referred to earnestly desired.

(2) Whereas, The sanitary science section of this academy has considered the subject of the proposed establishment of state sanatoria for consumptives, and it has been learned by scientific methods that such sanatoria, in other states and countries are efficient for the education and care of consumptives; therefore,

Resolved, That this academy respectfully petition the legislature of Michigan to establish at least one state sanatorium for the education and care of consumptives, and that an

adequate appropriation be made for that purpose.

Nature states that the Naples Academy of Physical and Mathematical Sciences offers a prize of 1000 lire to the author of the best memoir on the theory of the invariants of the ternary biquadratic form, preferably in connection with the conditions for splitting into lower form. The papers may be written in Italian, Latin or French, and must be sent in on or before June 30, 1904. In addition prizes are offered in connection with the legacy of Professor Luigi Sementini, who in 1847 left the sum of 150 ducats per annum 'to distribute it as a prize for three memoirs on applied chemistry which they shall judge the best, or to award it as a prize to the author of one single memoir containing great utility, or finally to give it as a life pension to the author of a classical discovery useful to sick mankind.' Competitors for this prize are invited to send in their applications, accompanied by manuscript or printed papers, not later than December 31, 1903.

MR. NEVILLE-ROLFE, British consul in Naples, refers in a report abstracted in the London *Times* to the widespread interest now being taken in Italy in the question of re-afforesting the country. In 1877 about four millions of acres were withdrawn from the operation of the old forest laws, as well as about one million acres in Sicily and Sardinia. The consequence was a reckless destruction of forests; and now it is generally admitted that the state must step in to save those that are left and to aid in replanting. The question now being discussed is what trees are to be used for the latter purpose. The Italian oak is of little use except for railway sleepers; there is plenty of chestnut all over the country, and pine-trees would grow luxuriantly and prove most useful. The cork-tree, however, appears to be the one which would prove economically the most valuable, and it has hitherto been almost wholly neglected in Italy. In 1900 the cork exported was valued at only £36,000, and much, no doubt, was used at home. But a few years ago Spain exported wine corks to the value of over a million sterling. In Italy about 80,000 hectares of land are under the cork-tree, chiefly in Sicily and Sardinia; in Portugal, Spain and Algeria the areas respectively are 300,000, 250,000 and 281,000 hectares. The Calabrian cork forests have been almost wholly destroyed, the trees having been burnt for charcoal, and even Sicily now imports corkwood in considerable quantities. Seventy years ago nearly all the cork imported into England went from Italy. But since then most of the Italian forests have been destroyed for charcoal and to produce potash, and those that remain are being devastated for the same purpose; and no one thinks of replanting the ground, which naturally gets washed away owing to the absence of trees. Large forests containing a majority of cork-trees are continually being released from the forests laws, and there is a risk that the production of cork in Italy will soon cease. Nothing can replace cork in its manifold use, and now when vast quantities are used in making linoleum and in shipbuilding an adequate supply of it is of great economical importance.

UNIVERSITY AND EDUCATIONAL NEWS.

THE board of trustees of Stanford University held a meeting on April 25, at which the formal transfer of the property of the university to the trustees was considered. It is understood that the transfer will be made during the present week. Mrs. Stanford will be elected president of the board of trustees.

THE New Hampshire legislature has voted an appropriation of $20,000 a year for two years to Dartmouth College.

AMONG the appropriations made by the state legislature to the University of Missouri there is one of $7,500 for an addition to the new building occupied by botany, entomology and horticulture. The addition will be used for experimental work in botany along physiological, pathological and ecological lines.

MR. ANDREW CARNEGIE has contributed $12,000 toward the amount needed for the erection of Emerson Hall, the new philosophical building of which Harvard University hopes to lay the corner-stone on May 25, the centennial anniversary of Ralph Waldo Emerson's birth.

This gift was made through Professor Münsterberg, and it brings the total amount now subscribed for this building up to about $140,000, or within $10,000 of the total which the university corporation requires before it will permit the corner-stone to be laid.

The new engineering building being erected at Brown University for the immediate use of the departments of Mechanical Engineering and Drawing will be ready for occupancy next September. The building is 72 by 84 feet, three stories high, and is designed so that a later addition of nearly equal size may be made to provide room for all the engineering departments.

The Technical Education Board of the London County Council is offering for competition five senior county scholarships, together with a certain number of senior exhibitions. The scholarships are of the value of £90 a year, and are tenable, under ordinary circumstances, for three years at universities, university colleges or technical institutes, whether at home or abroad.

The board of governors of McGill University have decided that the faculty of comparative medicine and veterinary science at the university shall cease to exist at the close of the present session. The reason given for this step is the impossibility of securing adequate funds for the reorganization of the faculty along the lines suggested by the governing staff of the university.

N. M. Fenneman, professor of geology at the University of Colorado and C. K. Leith, assistant professor of geology at the University of Wisconsin, have been appointed professors of geology in the latter university in view of the election of Professor C. R. Van Hise to the presidency.

At the annual meeting of the regents of the University of Nebraska on April 24 and 25, Frank G. Miller, of the Yale School of Forestry, was elected professor of forestry, his services to begin September next. The following promotions in scientific positions were announced: H. R. Smith, from associate professor of animal husbandry to professor of animal husbandry; J. H. Gain, from instructor in animal pathology, to adjunct professor of animal pathology; F. E. Clements, from adjunct professor of botany to assistant professor of botany; G. H. Chatburn, from adjunct professor of mathematics and civil engineering to assistant professor of civil engineering; A. L. Haecker, from assistant professor of dairy husbandry to associate professor of dairy husbandry; F. W. Smith, from instructor in education to adjunct professor of education; R. A. Emerson, from assistant professor of horticulture to associate professor of horticulture; A. L. Candy, from adjunct professor of mathematics to assistant professor of mathematics; R. E. Moritz, from adjunct professor of mathematics to assistant professor of mathematics; C. C. Engberg, from instructor in mathematics to adjunct professor of mathematics; T. L. Bolton, from adjunct professor of philosophy to assistant professor of philosophy; C. A. Skinner, from adjunct professor of physics to assistant professor of physics; R. H. Wolcott, from assistant professor of zoology to associate professor of zoology; W. A. Willard, from instructor in zoology to adjunct professor of zoology; G. H. Morse, from associate professor of electrical engineering to professor of electrical engineering. Among other appointments are the following: H. H. Waite, to be assistant professor of bacteriology and pathology; H. L. Shantz, to be instructor in botany; R. S. Lillie, to be adjunct professor of physiology. Fellowships were announced as follows: G. G. Frary, chemistry; H. L. Shantz, botany; Esther P. Hensel, botany. G. F. Miles was announced as scholar in botany.

Among the members of the summer school of the University of California from other institutions will be Professor Palmer, of Harvard, in ethics, Professor Angell, of Chicago, in psychology, Professor Monroe, of Columbia, in educational method, Professor Palache, of Harvard, in mineralogy, and Mr. Gifford Pinchot, chief of the Bureau of Forestry.

Norton A. Kent, Ph.D., formerly assistant at Yerkes Observatory, is at present in charge of the department of physics at Wabash College, Crawfordsville, Indiana.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 15, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*MEDICAL EDUCATION IN THE UNITED STATES.**

ONE of the chief objects of the organization of the American Medical Association was the elevation of the standard of medical education in the United States. In the president's address, the Father of the Association, Dr. N. S. Davis, stated that 'the purpose of the organization was the improvement of our system of medical education and the direct advancement of medical science and practice.'† That medical education in that day was defective, as recognized by the founders of the Association, is shown by the report of the Committee on Medical Education in the year 1850. The committee said, in part, as follows: "Medical education is defective because there are too many medical schools; the teachers are too few. There are too many students. The quantity of medicine taught is too limited; the quality too superficial, and the mode of bestowal of the honors of medicine too profuse and too unrestricted."

* President's address, delivered at the fifty-fourth annual session of the American Medical Association, at New Orleans, May 5–8, 1903.

† Transactions A. M. A., Vol. XVI., 1865.

For many years the association showed its interest in and attempted to influence the elevation of the standard of medical education through a committee on medical education. The 'Transactions' of the association of the earlier years show many reports of this committee, which display much thought and effort on the part of the association to improve the status of medical education at that period of time. James R. Wood, as chairman of the committee, in the year 1858, recommended that the various medical colleges of America be requested to send delegates to a convention of medical colleges, to consider the matter of medical education. This movement finally resulted in the formation of the Association of American Medical Colleges, which thereafter represented, to a degree at least, the American Medical Association in its efforts to improve medical education. Later, the Southern Medical College Association was formed. Together these associations represent about 80 per cent. of the regular medical schools of the country, and these colleges have, in a general way at least, fulfilled the minimum requirements prescribed by the rules of the associations in regard to the preliminary education of students, the length of the college course, and the character of the curriculum.

About twenty-five years ago the Illinois State Board of Health, through the splendid efforts of Dr. J. H. Rauch, its secretary, made a report on the number and character of the medical schools of the country. This board adopted a minimum of requirements of medical schools as a necessary step toward the recognition of their diplomas by the State Board of Health of Illinois. This minimum requirement of the State Board of Health was gradually increased from time, with the result that many of the medical schools were obliged to raise the standard of medical education to enable their graduates to obtain licenses to practice in Illinois. Other states followed Illinois in requirements for better methods of medical education, with the result that the standard of education in the country was very much improved.

MEDICAL SCHOOLS OF THE COUNTRY.

In the earlier days of our country, the need of physicians was met by the organization of medical schools which were, as a rule, proprietary in character. These schools attempted the education of physicians on the then existing conditions of medicine by teaching in a didactic way the principles and theories of medicine and surgery. The branches usually taught at that time consisted of anatomy, physiology, chemistry, materia medica, obstetrics, the practice of medicine and of surgery. But little opportunity was offered in the great majority of the schools for extensive, practical teaching in anatomy or chemistry, and but a moderate amount of clinical work in the so-called practical chairs. The course of medicine in the college consisted of two annual sessions of four or five months. The course was not graded. The student attended all the lectures and clinics taught during his first year, and the second year was a repetition of the first. This class of schools was rapidly increased in the course of time. The chief reasons therefor were the fact that it was recognized that a connection with a medical school was profitable, directly and indirectly. The prestige which the teacher enjoyed among the graduates and the laity brought him a remunerative consultation and private practice. In most of the states it was easy to incorporate and obtain a charter for a medical college. It cost comparatively little to conduct and maintain the institution. Lecture rooms were obtained at trifling cost. The dissecting room was not worthy of the name of a laboratory, and the chief

expense in maintaining it was the cost of dissecting material, which was usually deficient in quantity and poor in quality. Medical schools were organized all over the country, without reference to the needs of the people. Medical education was prostituted. To obtain a sufficient number of students many institutions showed a most degraded disregard of the moral and mental qualifications of the matriculates. The income of the school was wholly derived from the tuition of students, and no applicant was turned away who had the cash with which to pay his way. To add to the facility of obtaining a medical college course, there were organized in some cities evening schools, the hours of college attendance occurring from 7 to 9 or 10 o'clock at night. These sundown institutions enabled the clerk, the street-car conductor, the janitor and others employed during the day to obtain a medical degree.

In spite of the general tendency to increase the facility by which a medical degree could be obtained, there was a force at work to improve the methods of medical education. A few older medical colleges and an occasional new one set the standard high in relation to the existing status of medicine. There were earnest, forceful medical men in some of the schools who fought for a higher standard for matriculation and graduation.

The medical college associations exerted a splendid moral influence for good, and the state boards in all the more advanced states have, by mandatory legislation, compelled the colleges to raise the requirements in reference to the preliminary education, the length of the annual session, the time of medical college study, the character of the curriculum, etc. As a result, the status of medical college education has been very much improved in the last twenty, and chiefly in the last ten years. But, improved as it is, there are evils which menace us, the chief of which still are too many medical schools, too many students, and inadequate facilities for the proper teaching of medicine.

The improvement in medical college requirements has increased the cost of the maintenance of the medical college to a degree that it is no longer a profitable financial venture. There can be no dividends. Indeed, the proprietors of the private institution must often make up a deficiency in the annual budget. In spite of this fact, medical colleges have continued to increase steadily.

In 1877 there were sixty-five medical schools in the United States. In 1882 this number had increased to 89, and 1901–2 to 156. The enrollment of students and the number of graduates have also increased, in spite of the fact that the requirements for matriculation and graduation have been increased. In 1882 there were* 14,934 matriculates, and this number was increased in 1901 to 26,417, and in 1902 to 27,501, an increase of about 100 per cent. in twenty years.

The number of graduates in 1882 was 4,115; in 1901, 5,444; in 1902, 5,002, an increase of about 25 per cent. in twenty years. If, in 1850, there were too many medical schools and too many students, what can we say of the condition to-day?

It has been estimated that there is an average of one physician to 600 of the population of the United States at the present time. The natural increase in the population of the country, and the deaths in the ranks of the profession, make room each year for about 3,000 physicians, based on the proportion of one physician to 600 of the population. With 5,000 or more graduates each year, a surplus of 2,000 physicians is thrown on the profession,

* *The Journal A. M. A.*, Vol. XXXIX., No. 10, p. 574.

overcrowding it, and steadily reducing the opportunities of those already in the profession to acquire a livelihood. The evil of an overcrowded profession is a sufficient cause of complaint, but the cause thereof is the important point for us to consider and, if possible, remove. To correct the evil, the ease and facility with which a medical degree may be secured in this country must be diminished. As before stated, there are now 156 medical schools in this country. Of these, 30 are sectarian, and 136 are so-called regular schools. Fifty-eight are medical departments of universities, of which twenty-four are state institutions. The relation of the medical school to the university in most instances is a nominal one only. In but few of them is the control of the faculty, or the finances of the medical department, vested in the university proper. In a very few of them the sciences fundamental to medicine are taught in the university. In the majority of these schools these departments are duplicated in the medical department, and are taught by members of the medical faculty. In most instances, too, the teachers of the fundamental branches are physicians who devote but a part of their time to teaching. They teach without a salary, or for a nominal one only. Their remuneration is obtained by private practice, to which they must devote their best energies, to the detriment of their value as teachers. The clinical department of these schools is, in most instances, wholly inadequate. The majority of such schools depend on the general hospitals situated near them for the privilege of the use of clinical material. Necessarily, these clinical advantages have great limitations, inasmuch as they can not be fully controlled for the purpose of proper bed-side teaching, or for scientific investigation. Some of the medical schools which are connected with state universities are situated in small cities where it is impossible to command an adequate amount or variety of clinical material. The connection with a university, which many of the schools enjoy, is, therefore, almost valueless in a pedagogic sense. The majority do not differ materially from the private or proprietary schools in their value as teaching institutions. Ninety-eight of the medical schools in the country are private corporations, organized, maintained and, as a rule, owned by the faculty. If, in earlier years, these institutions were sources of direct financial profit to the owners, they have ceased to be so now—at least most of them. The evolution of medicine has made it necessary to extend the laboratory method of teaching. As these schools attempt to teach the whole curriculum, the erection, equipment and maintenance of the necessary laboratories have so increased the cost of conducting the schools that they are usually no longer self-supporting. The temptation is in such schools to conduct them on a plane which shall just comply with the minimum requirements of the various state bodies, which regulate medical practice in the several states. They are maintained ostensibly to teach medicine, but in reality for the prestige which a professorship affords the teacher in his private and consultation practice. Proprietary schools depend on general hospitals and dispensaries for clinical material. What was said of the status of clinical teaching of the medical departments of the universities is true also of the proprietary college. These schools can not hope to improve their present standards. The majority attempt to maintain laboratories and other expensive means of teaching which a modern medical education demands. But in how many are the laboratories worthy of the name? What kind and variety of instruments and apparatus do

they afford? Are their teachers of the sciences of the fundamentals of medicine capable? They can not hope for better conditions, because the time when a student's tuition will pay the school for his instruction, if he is properly taught, will never return. Medical education of the future must be based on the status of medical science. That basis is recognized now, but is attempted in the great majority of our medical institutions in a very superficial way.

SCIENTIFIC MEDICINE.

The great and important discoveries of Pasteur and the practical methods devised by Koch in bacteriology marked a new era in medicine. Before the facts made clear by these discoveries, the hypotheses and theories of other days have disappeared. Our knowledge of man and the lower animals and of the diseases and evils which afflict them has been revolutionized within the last twenty years. The advance in medical knowledge has been greater in that period than in all preceding time. Medicine now embraces many more subjects, chiefly fundamental ones, than were known twenty years ago. Formerly a very superficial knowledge of a few isolated facts in general chemistry and human physiology and a memorized knowledge of human anatomy and of materia medica enabled the student to learn the practice of the art of medicine and surgery. Now, the problems which confront the clinician and investigator in medicine and surgery compel him to have a good and working knowledge of general, physical and physiologic chemistry, of general biology, bacteriology, pathology, physiology, embryology, pharmacology, histology and anatomy. The physician who has not a practical knowledge of these fundamental subjects can not clearly understand the methods of others engaged in scientific investigation, nor can he rationally utilize the discoveries of others in his work. Medicine to-day is applied science. If we utilize the knowledge of to-day in an attempt to cure and prevent disease, it must also be an experimental science. No one can practically apply or rationally experiment with what he does not know. The fundamental studies of medicine must, therefore, be acquired by all who desire to successfully apply them as sciences. The successful experimental application of these sciences has given us within ten years a knowledge of the method by which the invading bacteria affect the host, and has likewise developed a principle of wide application as a preventive and cure of certain diseases by the use of antitoxic sera. It has confirmed the principle of preventive inoculation, accidentally discovered by Jenner, and has enabled us to apply the principle in other diseases than smallpox. It has enabled us to know the methods of transmission of certain infectious diseases, and to know how to stamp out scourges like yellow fever, the plague and malaria.

Through the evolution of Listerism, it has enabled the surgeon to invade every region of the animal body, and to save scores of lives formerly doomed to death. The freedom with which the surgeon may now operate has not only saved lives, but, indirectly, the knowledge of disease processes so studied during life has taught us many new facts in symptomatology, and has cleared away many fallacies concerning pathologic processes. It has given us many new methods of clinical study, and furnished data from the blood, the spinal fluid, the exudates, the sputa, the sweat, the feces, and urine, which enable us to recognize disease much more readily than before.

Much as has been accomplished by experimental medicine in a comparatively brief period of time, there are vast fields to which the method has not been applied.

With most of us, our present methods of clinical observation enable us to do little more than name the disease. In the vast majority of the infectious diseases we are helpless to apply a specific cure. Drugs, with the exception of quinin in malaria, and mercury in syphilis, are valueless as cures. The prevention and cure of most of the infectious diseases is a problem which scientific medicine must solve. What is true of the infectious diseases is also true of the affliction of mankind due to chemical influences within the body. We know but little of diabetes, of the primary blood diseases, or of the various degenerative processes of age and disease. We hopefully look to chemistry to reveal to us the cause of these and other conditions. Experimental medicine must be the means of removing the ignorance which still embraces so many of the maladies which afflict mankind. Not every student, nor every physician, can become an experimenter in applied medicine. Nevertheless, every physician must be so educated that he may intelligently apply the knowledge furnished him by experimental medicine in the cure of such diseases as can be cured. He will no longer juggle with the life of his patient by an attempt to cure with drugs or otherwise, where no help is possible.

METHODS OF MEDICAL EDUCATION.

The phenomenal evolution of medicine has multiplied the subjects of medical study. The character of these sciences requires that they shall be taught by the laboratory method. The laboratory method, too, has been adopted as the chief method of instruction in anatomy, pharmacology and chemistry, formerly almost wholly taught in medical schools by didactic lectures. The laboratory method, while necessary to the proper and practical instruction of the student, involves an expense which is appalling when compared with the methods of teaching formerly practiced in all schools, and still adhered to in many medical schools. The method is expensive, inasmuch as it involves more extensive buildings, much expensive apparatus and an increase of the teaching force. The instruction must be individual or to small groups of laboratory workers, and this involves also an extension of the time of instruction. A physician engaged in private practice can not possess and retain the general and technical knowledge necessary to enable him to teach one of the fundamental sciences properly, nor can he devote an adequate amount of time to it. The teachers of these fundamentals must be investigators in the province of their respective sciences. They must give their whole time to the instruction of students and to original investigation. The thoroughness and accuracy of the training of the special senses, and in experimenting, which a student will receive from such teachers in properly equipped laboratories, will make him keen in intellect and sound in judgment. His desire for knowledge will be stimulated by the atmosphere of his surroundings, and will awaken in him a consciousness that through him and his work the knowledge of the world will be increased and humanity benefited thereby. But teachers of this character must be paid salaries quite as large as the remuneration of professors in the departments of arts, literature and science. The salaries of such professors and of the corps of assistants which the laboratory method implies make the cost of the university or college far beyond the income which could be derived from the tuition of students. I believe it has been estimated that the laboratory method of instruction, now followed by all first-class institutions of learning, costs annually from $400 to $500 per student. But, great as the cost seems, it must

be conceded that the present status of medicine demands the thorough instruction of students in these fundamental studies. It matters not whether his future may be that of a teacher or a practitioner of medicine. In either event, he must apply his knowledge of the fundamental sciences to his work, and the result will depend on the thoroughness of his education.

APPLIED MEDICINE AND SURGERY.

To enable the student to utilize the knowledge of a thorough training in anatomy, physiology, chemistry, pharmacology, physiologic and physical chemistry, embryology, neurology and pathology, he should be afforded facilities of equal rank in clinical medicine and surgery. To supply the student with proper clinical facilities involves several important features. Special hospitals, which would be absolutely under the control of the medical school, would be necessary. The hospital should be constructed with a definite idea of teaching students and of making researches into the nature, causes and treatment of disease, as well as to care for a definite number of patients. Hospitals for general medicine, surgery and obstetrics would be essential. Such hospitals, with laboratories and equipped with instruments, apparatus and library, would cost for their building and maintenance a very large sum of money. With such hospitals it would be necessary to choose the professors of medicine, of surgery and of obstetrics, with competent assistants, of the same type as the teacher of the fundamental sciences. They should give their whole time to the work of teaching and to original research in the hospital. They should be men who have proved their scientific fitness for the important positions by the contributions they have made to medical knowledge. They should rank with and receive the pay given to professors of important departments in arts, philosophy and science. When so paid, they would be free to devote all their energy to teaching, and to experimental medicine—a career which would enable one to be of the greatest possible service to mankind. No life's work could be fuller or of greater self-satisfaction, and surely none would be more honorable. From these teachers and investigators the student would obtain instruction of the same systematic methods of accurate observation and investigation which are employed in the fundamental branches. He would receive thorough, conscientious drill in the fundamental methods of examination of patients, and his knowledge of the fundamental sciences would be constantly applied in this work. The trained clinical teachers would direct the student in thorough, careful observation in the wards and at the operating table, would collect data to be submitted to experimental tests, and would conscientiously carry out the experiments in the laboratories of the hospital.

The brilliant discoveries which have made our knowledge of the cause and means of transmission of many of the infectious diseases have been chiefly due to the introduction of the experimental method of investigation. Teachers and investigators of the type mentioned will have the opportunity to make equally important discoveries in the broad field of the unknown in medicine. They will train students in the methods of research work and constantly increase the number of investigators in the domain of medicine. And there is need for such men. We may give the great practitioners who have taught clinical medicine their due meed of credit for their excellent, painstaking, unselfish efforts as teachers. They have added to the sum total of our clinical data, have utilized the knowledge of the pathologist and the physi-

ologist in diagnosis, and have tested and judged the worth of therapeutic aids in the treatment of disease. But as teachers they have not made students investigators or experimenters. Not one of the recent great discoveries in medicine has been made by such a man. He has used as clinical material hundreds of cases of pneumonia, rheumatic fever, tuberculosis and chronic diseases by the score; his experience has taught him to recognize these diseases, even when the clinical manifestations are obscure, but he is no more successful than when he began to practice in saving the life of the patient with pneumonia, in preventing endocarditis in rheumatism, in curing tuberculosis, or in checking the advance of a chronic hepatitis. It is time, therefore, that the clinical teacher should have the knowledge necessary to carry on experimental investigation, with hospital facilities for the work that the profession may become purged of the shame of helplessness in curing so many of the common diseases of mankind.

The patients who will be received in these hospitals will be fortunate. They will receive the most painstaking examination and study, and the experiments made on animals in the laboratory will benefit the patients directly, inasmuch as more rational therapeutic measures will be applied in cases so investigated. In addition to the clinical teachers, who will devote all their time to teaching and research work in the special hospitals, there will be quite as much need for the clinical teacher, who is in private practice, in the general hospitals. Under his direction the student may himself investigate a hospital or ambulatory case, and undertake the care of the patient. His rich and varied experience in hospital and private practice will enable him to round out the student's college education. He will impart to the student a better idea of medicine as a whole. He will coordinate and arrange the isolated facts of clinical and laboratory investigation, and give them their true and relative value. He will teach the student the art of medicine; he will teach him that human sympathy and encouragement of the sick and dying are a part of his duty as a physician.

It would be most practical to make the clinical work of the third year a clinical drill and experimental course, given in the special hospitals, and assign the students of the fourth year to the general hospitals and to the clinical teachers who are in private practice. All the general hospitals and dispensaries controlled by the medical schools could be utilized in the fourth year for this purpose, and afford the student an abundance of clinical material and the benefit of the experience of many clinical teachers. Many of the assistants in the special hospitals, of the third year course, would doubtless engage ultimately in private practice, and would, because of their scientific attainments, make excellent clinical teachers in the fourth year. A medical school conducted on the high plane advocated must necessarily be under the control of a university. Such a medical school would cost an enormous amount of money, and this can be commanded only by the trustees of a university of the highest order. That the money for the purpose of establishing and maintaining university medical schools with research hospitals and university clinical courses will be forthcoming can not be doubted. The world is awake to the great discoveries recently made in medicine. The wealthy men of this country have had their interest aroused as never before in reference to the possibilities and benefits which medical investigation will give to mankind. They now recognize that they and all posterity will

be benefited by every new fact discovered in medicine, and that physicians thoroughly and scientifically trained are necessary to conserve the health of the people.

Three years ago Professor W. W. Keen, in his address as president, deplored the fact that medical schools received relatively little aid in the form of endowments as compared with universities and colleges of philosophy, art and theology. Since that time several millions of dollars have been given for medical education and scientific research. The signs of the times point to a brighter future of medicine in America.

EDUCATION PRELIMINARY TO MEDICAL STUDY.

The subject of the educational requirements for matriculation in medical schools has been discussed at many meetings of this Association in its earlier years, and later by the college associations, by the American Academy of Medicine and by the various state boards of health.

The requirements were at first lamentably low, and the efforts of the Committee on Education of the American Medical Association and of the college associations had but little effect, because they possessed no legal power to control the schools.

The influence of the various boards of health of several states, notably Illinois, was more marked, inasmuch as these state boards possessed a mandatory power. The colleges were forced to adopt the minimum educational requirements of the state boards of health if their diplomas were to be recognized by the respective state boards.

These moral and legal influences to improve the preliminary requirements were almost nullified by the practice of a majority of the medical schools in admitting students whose educational status was examined into and judged by a committee of the college faculty.

This practice is still followed by a majority of the medical schools, and results in the admission of many students who are unable to fulfil the prescribed requirements. As a subterfuge, students are often matriculated conditioned in one or even several subjects. Then the student and the faculty committee forget all about the subject, and the student completes his course, goes into practice, and dies with the conditions still undischarged.

The present requirements of the college associations and of the various state medical examining boards and state boards of health amount, on the average, to a high-school education. The curricula and length of course of the high schools of the different states, and even in the same state, differ very substantially. However, if the medical schools now in existence would honestly require as a minimum education the diploma of a high school, without regard to the rank, it would be a marked advance over the present requirements as practiced by most schools.

We must admit, too, that there are medical schools of such low educational grade that they have no right to demand of their matriculates as much even as a common school education. This fact that low-grade medical colleges exist is one of the most satisfactory explanations of the difficulty encountered in elevating the standing of preliminary requirements.

To get at the root of the matter the medical college must be brought up to the proper educational standard, and then, and then only, can be made a proper preliminary educational requirement.

UNIVERSITY MEDICAL COLLEGES.

The present status of medical science requires and demands a university medical college course. By university medical college is meant a medical school which is directly connected with and a part of a university; the university fixing the requirements and controlling the admission of stu-

dents to the medical department. The method of teaching both the fundamental and the clinical branches is on the principles outlined above. To properly prepare for such a course the student should have, as a minimum preparation, at least two years of study in a good college or university. The requirements to enter a good college or university would insure a sufficient knowledge of the ordinary school branches and also Latin or Greek. During the two years' course in college his time would be well spent in the study of English, French, German, mathematics, history, philosophy, physics, chemistry, general and organic, and qualitative analysis, comparative anatomy and general biology. The amount of time to be devoted to each of these subjects would be the same as that of students of general science, as arranged in all college curricula, with the exception of a much more thorough course in chemistry, biology, physics and comparative anatomy.

So prepared, the medical matriculate would be able to grasp all the intricacies of the subjects of the fundamental branches of medicine. With the addition of the full medical college course, as outlined above, his education would be equal in culture to that of the graduate in arts and philosophy. At the same time, it would be practical and especially fit him for his work as a scientific investigator or practitioner, or for both.

With the medical profession so educated a physician would be, in truth, a member of a learned profession. From an educational point of view he would rank as an equal with the scholar in philosophy, law and theology. As a man he would be recognized as the greatest benefactor of mankind.

With the establishment of university medical schools the first two years of work in the medical school will consist of courses in pure science. Then, doubtless, all universities will adopt the plan which two or three universities have already put in practice. That is, that the student who completes the first two years of the science course of a university, or at a college of good standing, may enter the sophomore year of the university and take the first two years' work in medicine, as the sophomore and senior years of the bachelor's course, when he would receive the degree of S.B. The student who completes the three years of the arts or philosophy course at a university, during which he should take a large amount of work in physics, chemistry and biology, could then enter the medical college and after two years receive the degree of A.B. or Ph.B. After two years spent in the clinical school he would receive the degree of M.D.

This telescoping of the literary and medical courses affords the advantage of an economy of time, while it does not in any way lessen the value of the result to the student. In the one case the student secures the degrees of S.B. and M.D. after six years of study, and in the other the degrees of A.B., or Ph.B., and the degree of M.D. at the end of seven years' study.

THE OUTLOOK OF MEDICAL EDUCATION IN THE UNITED STATES.

Medical education must advance to its proper level if it complies with the present status of the medical sciences and the demands which continued evolution in medicine promises.

What does this imply? It means that the private—the proprietary—medical school which is conducted for commercial reasons must go. Acknowledge, as we must, the great value which the best of these schools have been to the profession and to the country, all such schools have

lived past the time when they can be of value. The continuation of these institutions henceforth will be harmful. They can not command the money to build, equip and maintain the laboratories and hospitals which a proper and adequate medical education demands. In the past their graduates have furnished the many great and influential medical and surgical clinicians of this country. In former days a graduate poorly prepared has been able, by indefatigable labor and post-graduate work, to place himself in the front rank as a clinical physician and surgeon.

To-day medical science demands primary instruction to fit a man as an investigator and scientific physician. If not properly educated he can not grasp the great problems which medicine presents to-day as he did the more simple clinical facts which comprised the art of medicine and surgery a few years ago. In the future medicine must be taught in the large universities of the country and in the state universities which are situated in or near large cities, where an abundance of clinical material may be commanded.

The state university and the college which desires to teach medicine, and is so situated that it can not command clinical material, should confine itself to teaching the sciences fundamental to medicine. These should be taught as pure sciences, and should be included in the course for the degree of S.B. A college or state university ambitious to teach the medical sciences can do so without great cost. To attempt to teach applied medicine without proper and adequate hospitals, and with an insufficient number of patients, would be irrational, nor can they command the necessary funds with which to do it. From such colleges and state universities the students could go to the larger institutions which are able to furnish the proper facilities for teaching applied medicine and surgery.

The general hospitals of many of the cities, now used by proprietary schools, could be utilized as clinical schools for both undergraduate and post-graduate teaching, conducted by the clinical teachers in the existing proprietary schools. Indeed, these hospitals could be utilized as university extension clinical courses. Necessarily, they would have to be under the control and direction of a university medical school.

How many schools may be necessary to educate the number of doctors of medicine required annually in the United States? The question one can not answer, but it is safe to say that 2,500 graduates annually will fully supply the demand. This would imply about 10,000 to 12,000 matriculates. A minimum number of twenty-five and a maximum number of thirty-five medical schools should offer sufficient facilities to educate 10,000 students. The various state universities and the colleges which offer adequate science courses would educate a great number of students in the fundamental branches, or in the first two years of the medical course.

MEDICAL RECIPROCITY BETWEEN THE STATES OF THE UNION.

The low requirements of some medical colleges, and the want of uniformity in the requirements for a license to practice in the different states, has resulted in a condition which entails much hardship on a physician who desires to remove from one and to engage in practice in another state. The rules of most state boards of medical examination and of health are so stringent that a physician or surgeon of years of experience and of acknowledged skill and education, and the specialist who may be renowned in his field of work, are obliged, like the recent graduate, to take an exam-

ination in all of the branches of medicine and surgery in order to secure a license to practice in the state of his adoption.

To correct this evil it has been suggested by a member of the American Medical Association, and concurred in by others, that a national board of medical examiners be organized; that the board hold examinations at different seasons of the year in the various large cities, and that the diploma so obtained shall be recognized as a license to practice in any one or all of the states and territories. The measure suggested seems to be practical and feasible.

In addition to this plan, it remains to be said that the degree granted by the future university medical school will be undoubtedly recognized as an evidence of fitness to practice in any state in the Union. When we shall have a less number of schools and annual graduates the various states may safely and rationally become more liberal and discriminating in the conduct of their office.

THE INFLUENCE OF THE AMERICAN MEDICAL ASSOCIATION.

The American Medical Association should maintain its interest in the elevation of the standard of medical education, one of the chief reasons of its organization. Its influence in former years was principally moral. This was of considerable value, for the reason chiefly of the high ideals of the founders and first members of the association, who advocated and fought for a higher standard of medical education. In the future its influence should be many fold that of the past, for with the reorganization of the profession, the better methods of conducting its affairs, the increased and probably very large membership, and its great medical journal, it should wield a great influence for good.

As the direct agent by which the American Medical Association may exert its influence in the elevation and control of medical education, the Committee on Medical Colleges and Medical Education should be made permanent and should be given adequate power and sufficient annual appropriation to make its work effective.

This association should, therefore, stand for, and should use its whole power to improve, medical education in this country. It is said that we never exceed our ideals in practice, and that if we lower our ideals our conduct sinks to a lower level.

The American Medical Association should take as its ideal and standard of medical education the university medical college, with all the name implies in regard to the fundamental medical sciences, and to the clinical branches. It should use its influence to drive out of existence those proprietary medical schools which are conducted solely as money-making institutions. These measures can not be accomplished at once; but medical science demands it, the profession demand it, the people demand it, and look to the American Medical Association as the chief influence which shall accomplish this end.

FRANK BILLINGS.

CHICAGO.

*THE RARE EARTH CRUSADE; WHAT IT PORTENDS, SCIENTIFICALLY AND TECHNICALLY.**

IN the movement of economic and social forces the closed century knew four periods of intensified activity. In 1775, a memorable date in American history, Watt began the manufacture of the steam-engine. During the adolescence of our own country revolutions were wrought in the commercial world by the invention of the locomotive by Trevethick (1801), the loom by Jacquard (1801), and Fulton steamed upon the Seine. By the beginning of the nineteenth century the inventions of Watt and

* A lecture delivered before the Chemists' Club, New York, by request, April 8.

Boulton, Arkwright and Hargreaves, were completed and something like the modern factory system was begun. From industrial history we gather that 'England increased her wealth tenfold and gained a hundred years' start in front of the nations of Europe.'

While vigorous protests, some even violent, as the riots at Lyons and the destruction of Hargreaves' home in England, were made against this rampant spirit of industrialism, there was witnessed a literary renaissance in Great Britain second only to 'the spacious times of great Elizabeth.' That age nourished Keats, Shelley, Byron, Scott, Coleridge, Wordsworth, Burns and Burke. C. Alphonso Smith in his exquisite essay on 'Literature and Industrialism' says: 'In a love of nature that made all seasons seem as spring, in devotion to democratic ideals, in variety of range and intensity of feeling, this period takes precedence of Elizabeth's reign.' It was of this age that Wordsworth said:

> "Joy it was in that dawn to be alive,
> But to be young was very heaven."

Granting Tolstoi's definition of science as a 'mere gratification of human curiosity,' we realize that 'science is history making,' for it was in this period that Volta and Galvani (1801) gave us a source of power and a means of applying it. At the close of the time Dalton had announced the atomic theory and Davy had obtained the alkali and alkaline earth metals.

In the second period, about 1840, there accumulated the potentialities that shaped what is termed the Victorian Era. Quoting Smith again, "In those years railroads first began to intersect the land, telegraph lines were first stretched and the ocean was crossed for the first time by steam-propelled vessels. All these mechanical triumphs tended to annihilate time and space. The products of manufacture could now be sent with dispatch to the most distant quarters. Nations came closer together. The two hemispheres became, and have continued, one vast arena of industrial and scientific interchange. * * * "

The literary record of this period contains the names of Tennyson, Goethe and the Brownings as poets; Dickens, Thackeray and George Eliot in fiction; Ruskin and Carlyle in miscellaneous literature. In America, during this Mexican War period, we had Longfellow, Lowell, Whittier, Hawthorne, Emerson and Holmes, 'the six names that have given the New England states their incontestable supremacy in American literature.'

The part played by the south in literature during these periods was not prominent. The preeminence of that part of our country in forensic art and oratory need not be considered, nor need we discuss the social conditions, and honest difference of opinion as to the proper interpretation of the true relationship of the government as a whole and the integral states which constituted it, other than to say that the south, conquered, as was necessary, came out of the Civil War with new economic ideas, with a renewed and 'ever-increasing development of her natural resources, with a more flexible industrial system, a more rational attitude toward labor, and more enlightened methods of education and with it there came a literary and scientific inspiration impossible before.' In the year 1870, our third period, which statisticians take as the birth year of the new industrial movement in the south, flashed out new literary stars such as Sidney Lanier, Charles Egbert Craddock and George W. Cable. That year can not be named in the presence of scientific men without our thoughts reverting at once to the names of Mendeleeff and Meyer.

The last period is but as yesterday, even to-day.

"All the world's a stage
And all the men and women merely players."

It has been called the age of trusts and mistrusts. In it we must realize that science and its applications must face vested interests; these must be overwhelmed or its universal monopolistic rights be pigeonholed by purchase. Let us realize, however, in this time, as Boyle has said, that 'men often suffer as much cold and wet and dive as deep to fetch up sponges as to fetch up pearls.'

In 1788 Geyer discovered the new mineral, gadolinite, and in 1794, the Finnish chemist, Gadolin, separated a new earth, or oxide, in a black mineral found at Ytterby near Stockholm, and called it yttria. In 1803 another Scandinavian mineral, then known as 'the heavy stone of Bastnäs,' or cerite, was discovered by Berzelius and Hisinger and Klaproth in Germany.

In 1839 Mosander discovered lanthanum in this earth. Three years later he resolved it into two elements, one giving a white oxide and the other a pink, namely true lanthanum and didymium. Scheerer noted that yttria, which is white when heated in a closed vessel, becomes yellow when heated exposed to the air. He, in consequence, assumed that it was a complex substance and the year following (1843) Mosander proved that it could be resolved into three earths, one being colorless (true yttria), the second rose-colored (terbia), and the third (erbia) giving colored salts, but a deep yellow peroxide.

H. Rose in 1839 analyzed samarskite and showed it to be a columbo-tantalate of iron and calcium on the one hand and yttrium and cerium mainly on the other. Satisfactory analyses of this mineral, however, were not had for almost a half-century (Swallow, Allen and Smith), when its comparatively abundant occurrence was noted in North Carolina.

Shortly after the discovery of the spectroscope, Gladstone in 1859 observed the surprising fact that certain substances gave absorption spectra, especially didymium. This constituted the first important and is now, perhaps, the most valuable criterion in the investigations of many of the rare earths.

In 1860, Berlin, by means of partial decomposition of the fused nitrates, showed the presence of but two earths where Mosander had reported three, namely, yttria, as given above, and a rose-colored body, which was termed erbia. A reversal of names occurred, for two years later Bahr observed the characteristic absorption spectrum of erbia and Delafontaine found it in Gadolin's yttria and Mosander's yellow peroxide. The typical oxide was assumed to be RO, and it remained for Mendeleeff in the enunciation of the Periodic Law (1870) to give lanthanum the present accepted formula for its oxide, La_2O_3.

These elements were obtained as metals —in the then accepted pure form—and Hillebrand and Norton determined the specific heats, which data have aided subsequent workers materially. These determinations, in the light of knowledge gained within recent years, possess a quondam value, however much care and energy may have been expended in securing them.

In 1878 Delafontaine stated that samarskite contained much terbia. He separated a more soluble formate and announced the new element philippium, which Roscoe, although he noted band λ 450, proved to be a mixture of yttrium and terbium. This band in reality belongs to dysprosium, discovered by Lecoq de Boisbaudran. The same year Delafontaine, having found a mare's nest in samarskite, from which Mosander separated erbium, announced decipium. The absorption bands attributed to this element were λ 416 and λ 478,

which were subsequently appropriated by samarium, reported as a constituent of didymium by de Boisbaudran. Samarium would now have the name of decipium, but for the fact that, in 1881, Delafontaine declared his decipia could be resolved into an oxide without absorption spectrum (true decipia) and one with these lines, or samarium.

J. Lawrence Smith, of Kentucky, in the seventies, announced mosandrum in samarskite. Marignac and Delafontaine independently pointed out that mosandrum was the same as terbium, while later de Boisbaudran demonstrated that it was a mixture of terbia and gadolinia. This 'nebula of elementary matter,' as Petterson puts it in that charming account of the life work of Nilson, appeared to clear up through the work of the English, French and Swiss chemists, Roscoe, de Boisbaudran and Marignac. While 'the beginning of creation is light,' as Carlyle says, the millennium has not yet arrived, for the earths obtained from gadolinite began to break up into a number of new earths.

Cleve (1873) found that the bands of erbium with an atomic weight of 170.5 could be split into those belonging to one element forming a red oxide with the characteristic emission spectrum (by incandescence) of old erbium and another group of two absorption bands in the visible spectrum. These were shown to belong to thulium.

Five years later Marignac found all the absorption bands could be eliminated by successive fractioning, whilst the atomic weight of the remaining oxide increased. This oxide gave colorless salts without absorption bands, and the name ytterbium was assigned to it, with an atomic weight of 172.5. In the erbia fractions Soret found bands which could not be attributed to erbium. This body, designated X, subsequently proved to be Cleve's holmium.

Material giving out, Marignac, with the true scientific spirit, begged other and younger men to take up the work, using larger amounts. This Nilson did and verified Marignac's work. Just before reaching the same point Marignac arrived at, however, Nilson obtained a nitrate of a less basic material of lower atomic weight. One fraction continued to drop, while the other rose until, in the year following (1879), assisted by Thalèn, who examined the products with the spectroscope, Nilson separated probably the two best defined of the rare earths, scandium (44.1) and ytterbium (173). Nilson showed the location of these elements in the Mendeleeff table, the properties of the former having been predicted.

Referring to these elements Mendeleeff says: 'These metals which are rare in nature, resemble each other in many respects, always accompany each other, are with difficulty isolated from each other and *stand together in the periodic system of the elements.'* The last statement is based largely upon analogy, a most valuable method of argument in scientific generalizations without doubt, but, as Davy once said: 'Analogy is the fruitful parent of error.'

In 1880 Marignac attacked samarskite, and by fractioning the double potassium sulphate obtained two oxides in almost pure state, as follows:

Yα giving a white oxide, colorless salts and no absorption bands. Six years later it was called gadolinium and the atomic weight 156 assigned it by Marignac, de Boisbaudran, Cleve and Bettendorff.

Yβ proved to be samarium of de Boisbaudran, or Delafontaine's original decipium. Marignac, Cleve, Brauner and Bettendorff determined its atomic weight (149–150). While the elementary character of

samarium was questioned by de Boisbaudran and Demarçay, as late as 1893, the latter stated that no real proof of the complexity of samarium had been offered. What an exquisite illustration we have here of Tyndall's dictum, 'Every system must be plastic to the extent that the growth of knowledge demands'; for, but a few years have passed before Demarçay (1901) announces europium, with atomic weight of 151 (approximately), obtained by prolonged fractionation of the double magnesium-samarium nitrate. His observations are reported as proved by reversal, absorption, spark and electric phosphorescent spectra. The element appears to lie between samarium and gadolinium, with several strong lines in the violet and ultraviolet.

In 1883 Crookes brought into consideration phosphorescent spectra obtained in a vacuum tube under the influence of an electric discharge. The year following Lecoq de Boisbaudran obtained another method of securing a phosphorescent spectrum. It is in fact an inverse spectrum, nearly related to that of Crookes, very delicate, being greatly influenced by small amounts of foreign bodies and other conditions. The brilliancy of the bands thus obtained does not depend upon the proportion of the active substance present. A small amount of the body with much inert material gives a bright spectrum, consequently it offered little promise as a method for following the process of fractionation.

Up to this time holmia and thulia had not been freed from the other earths. In 1886 de Boisbaudran showed that holmia was composed of true holmium (162) and dysprosium (?), adverted to, characterized by several bands, the one to which Sir Wm. Crookes called especial attention being λ 451.5. This Englishman later (1889) subjected yttrium salts to a great number of fractionations, several thousand, finding the bands of the original material distributed among the different fractions. From this work he assumed that yttrium could be split into a number of elementary substances, which he termed 'meta-elements,' naming one victorium after the lamented queen. Without doubt Sir William Crookes enunciated in this paper an important principle in inorganic research, namely, what may be termed 'partial cleavage'; that is, the fractioning of a complex mixture of elements may be pushed to an extreme with one compound and the bodies appear elementary. On applying another method, or the same method to another compound of the assumed elementary substance, the cleavage may be brought about in another direction, and so on. The 'genesis of the elements' was the natural theory offered by that master mind. It was strongly combated in the main, however, by de Boisbaudran, who showed that two of the bands obtained, $Z\alpha$ and $Z\beta$, are not at all related to yttria, as the former follows holmium and the latter is identical with terbium. He says, further: 'Perfectly pure yttria gives no phosphorescent spectrum.' Dennis, the American worker on the element in question, appears to agree with the French chemist.

It may be recalled that Delafontaine extracted samarium (his original decipium) from Mosander's didymium. The theoretical work referred to naturally gave rise to the complexity of didymium, which has an absorption spectrum characterized by a number of well-defined bands. In fact, Cleve made the prediction of the presence of another element in lanthanum and didymium in 1878. Carl Auer (von Welsbach), in 1885, by prolonged fractional crystallization of the double ammonium nitrate, obtained from the pink solution green salts of praseodidymium (140) and rose-red

salts of neodidymium (143). The absorption spectra of these two are complementary. The next year Crookes eliminated band after band of the didymium until only λ 443 remained. Krüss and Nilson and Kieserwetter and Krüss prepared didymium from several sources, fractioned the preparations and arrived at a similar conclusion. It is now known, as shown above, that erbium has been resolved into seven other well-characterized elements, viz., besides erbium (166.3), scandium (44.1), yttrium (89), terbium (160), ytterbium (173), thulium (170.7), holmium (162) and dysprosium (?). After the elimination of samarium, didymium shows at least nine distinct absorption bands: λ 728.3, 679.4, 579.2 to 575.4 (which is easily resolved into two), 521.5, 512.2, 482, 469, 445.1 and 444.7 (443) (ultra-violet and infra-red not considered). In short, these two elements neo- and praseodidymium consist of at least nine elements. The full conclusion of Krüss and Nilson may be stated in their own words: 'Nach obigen Auseinandersetzungen hätten wir an Stelle des Erbiums, Holmiums, Thuliums, Didyms, und Samariums die Existenz von mehr als zwanzig Elementen anzunehman.'

While the acceptance of such conclusions without question would be wholly unscientific, we must carefully consider the general idea involved, and the investigations upon which the conclusions were founded and the investigations carried out subsequently to test them. Absorption bands determined under variable conditions are not to be accepted as essential characteristics of new elementary substances, as they have been shown to vary with the salts used. Sorby and Liveing have shown that the character of the solvents and traces of impurities bear importantly upon the intensity of the absorption bands. Lawrence Smith and de Boisbaudran and latterly Dennis and Chamot have called attention to variations in the absorption spectrum of didymium, when nitric acid is present. Becquerel showed there were variations in the spectra of crystalline compounds of the same element. Very recently Muthmann and Stützel have shown that, if a substance be regarded undecomposable, its absorption spectrum varies considerably with dilution and amount of free acid present. Demarçay has urged the necessity of giving the thickness of the medium used, with a statement of its strength.

C. M. Thompson reported that didymium salts from various sources showed no material differences in absorption spectra. Schottländer remarks, however, that the material used contained several oxides, giving absorption bands, so the intensity of certain bands of a particular element may have been increased by the superposition of bands of other elements.

Crookes and Dennis independently made the extremely interesting observation that the heavy orange bands (575–579), which were resolved by Auer, were not altered in their fractions when the remaining lines had undegone some changes, hence the former stated that probably 'didymium will be found to split up in more than one direction, according to the method adopted.' The work of Dennis on the relative intensities of the bands observed, by varying the procedure of fractionation, is in direct accord with the observations of previous investigators as to the compound nature of neo- and praseodidymium.

Von Scheele (1898) carried out a series of investigations looking toward the proof of the elementary character of praseodidymium. Bettendorff, by a spectroscopic examination of the mother liquors obtained by the Welsbach method, confirmed the observations of Krüss and Nilson, especially with regard to the absorp-

tion bands in the blue portion of the spectrum. Schottländer, working with the same object in view, came by no means to the same conclusion. He held it probable that praseodidymium consists of a mixture of two elements, whose oxides burned in air give R_2O_3 and RO_2 (*i. e.*, $R_2O_3 + 2RO_2 = R_4O_7$, the accepted peroxide). His conclusion was founded upon the small per cent. of oxygen present in the peroxide. Forshing confirmed Bettendorff's results spectroscopically and reported Pr α characterized by the yellow bands, and Pr β, which has the three bands in the blue, indigo and violet. Boudouard arrived at the same conclusions. Brauner concluded, in his work on the oxides, 'from the tendency of them both (praseodidymium and neodidymium) to become more highly oxidized than would correspond to the formulæ Pr_2O_4 and Nd_2O_5, that praseodidymium and neodidymium may be further split up.'

Von Scheele maintains that none of the savants has proved Krüss and Nilson's theory that there are four elements present in praseodidymium. By long repetition of the Welsbach process he failed to bring about any variation in the yellow bands, which Bettendorff maintained could be fractioned away, and demonstrated to his own satisfaction the elementary composition of praseodidymium in a paper reciting much careful and patient experimentation. Unfortunately, he ignored the work of Crookes and Dennis, which is dependent upon variation of the finer details of manipulation. In our laboratory, following entirely novel lines of research for this element, we have apparently verified the conclusion of the complexity of the element in question.

The material used was generously presented by Mr. H. S. Miner, the long-time associate and successor of the lamented Shapleigh. It was quite free from neodidymium, but contained a notable amount of lanthanum. The presence of lanthanum facilitates the fractioning of didymium by the Auer method, as pointed out by Dennis. A pure praseodidymium compound is readily had by using the method of Baskerville and Turrentine, namely, fractioning a citric acid solution saturated with the hydroxide, and heating. The citrate obtained was converted into the oxide. This oxide was free from the other elements giving absorption bands in the visible spectrum. So far we have not been able to examine the ultra-violet, but shortly expect the arrival of one of Wood's nitrosodimethylaniline screens, which I am having made for my spectroscope. The instrument is a Steinheil plane grating (made by Brashear) with 14,438 lines to the inch, essentially the same as that described by Dennis in his work with Dales on yttrium, except a size larger. It was purchased by a grant from the Bache Fund of the National Academy. The oxide was proved to be free from elements which give no absorption band, especially lanthanum, by means of photographs of the arc spectrum obtained with a Rowland concave grating (15,000 lines to the inch and twenty-one-foot diameter). The spectrograph work was done by my friend Dr. W. J. Humphreys, of the Department of Physics, University of Virginia, and will be published by us in full at the proper time. The oxide was very carefully treated with hydrochloric acid, bringing about partial solution, whereby a distinct brown oxide was obtained different from the normal black peroxide; further, a separation has been secured by fusion with sodium peroxide.

Other methods of attack have been followed, as, for example, fractional crystallization from a concentrated chloride solu-

tion by means of gaseous hydrogen chloride, fusing with alkaline hydroxides, sodium dioxide, etc. The details will be given in the full papers when published.* Suffice it to say that we have succeeded in obtaining a preparation, which has lost entirely the absorption line λ 443 and another, very small in amount, which shows only that line. The oxide is bright green when heated in the air. The work of Crookes and Dennis is thus verified by entirely novel methods. Drossbach reports the existence of an element in monazite sand with an atomic weight of 100, that is, eka-manganese, but it is discredited by Urbain.

It may be interesting at this point to call the attention of the scientific men of America to the fact that from the locality, Ytterby, where cerite was found, four elements, yttrium, erbium, terbium and ytterbium, have secured a name. From the occurrence of samarskite and monazite (Mitchell and McDowell and other counties in North Carolina and Brazil), which contain most of these rare earths and have furnished so much of the material for the researches, not a single element is named, except the tentative carolinium, which will now receive attention.

The other rare earths to which I wish to direct your indulgent attention in a few words are those which possess radio-activity, a property accidentally rediscovered by Becquerel. It may be remarked that Sir George Stokes fifty years ago addressed the physicists of the British Association on the curious action of certain bodies in emitting light at ordinary temperatures. Little was then known of the phenomenon of fluorescence. There is not time to attempt a discussion of the origin and nature of radio-activity. It appears that our satisfactory Maxwellian theory of the progression of ethereal stresses may yet be harmonized with the older corpuscular view of Descartes and Newton by the recent elegant researches of Becquerel, J. J. Thomson, Rutherford, Giesel and others.

M. and Mme. Curie have been pioneers in utilizing this physical activity, which serves to detect the presence of minute amounts of certain elements contaminating hitherto well-defined bodies. J. J. Thomson, in his recent extremely interesting address at Belfast, brings out a point demanding the chemist's closest attention, namely, that the radio-activity is five thousand times as delicate as the spectroscope, it matters not whether the arc, spark, absorption or phosphorescent spectrum be made use of.

By prolonged fractionation the Curies separated radium from barium salts. Demarçay has prepared the spectrograph showing the characteristic lines of the element, while Madame Curie determined its atomic weight (225). It fits beautifully in Mendeleeff's table. The Curies have also announced polonium, or the active constituent of bismuth. Uranium appears to have been the first to show this property, as noted by Becquerel. Actinium, it seems, is the elusive body found in pitchblende by Curie, and appears to be the same as Crookes' uranium X.

Chroustschoff a dozen years ago announced that thorium contained another element, which he called russium. I have been unable to secure a copy of this paper or even to learn where it appeared. I am informed by Professor Mendeleeff, who

* I have been assisted in the numerous researches barely summarized in this address by Messrs. J. E. Mills, R. O. E. Davis, J. W. Turrentine, James Thorpe, Reston Stevenson, W. O. Heard, Hazel Holland, E. B. Moss, H. H. Bennett, Geo. F. Catlell and F. H. Lemly. The separate papers will shortly be published. Three grants of fifty dollars each have been made by the American Association for the Advancement of Science to aid in the work on the rare earths.

mentions it in his 'Principles of Chemistry,' that Chroustschoff made the announcement before the Russian Chemical Society, but had published no complete investigation. Two years ago, Brauner, working along one line, and I, on another, independently announced the complexity of that element.

It is generally accepted now from the published work that the property of emitting rays which affect the photographic plate is not a specific property of thorium, but characteristic of a constant contaminating constituent of that element. It is well known also that, while some of these radiations or emanations affect the photographic plate, some do not. The electrical method of measurement (quantitative) has been substituted in our work and improved methods of fractionation are being used, whereby we seem to be approaching a non-radio-active thorium and one possessing that property in high degree. Further, similar compounds of thorium fractions similarly treated show almost no difference with the Rowland grating referred to, yet show marked divergence in their radio-active properties. The radio-active work is being done by Mr. G. B. Pegram, of the Department of Physics in Columbia University.

I have not come from 'away down south' to the center of commercial activity of all the Americas to tell you how these rare substances are to be had at low cost, advertise their uses, form a combination and arrange for their sale at a good profit, although one of my neighbors ranks high among Knickerbocker mergers. The fourth period in rare earth activity is coexistent with the extension of the use of some of them for illuminating purposes. The price of thorium nitrate fifteen years ago was over five hundred dollars per pound. Now the market price is about five dollars per pound. Commerce required thorium compounds; they were provided. Commerce demanded thorium compounds at a reasonable price; the demands were met. The prices of certain of the impure rare earths occurring in nature with thorium are high, but their values do not follow well-known economic laws and are purely fictitious. When uses are found, the prices of these by-products will fit the demand.

In this maze of an enticing problem one imagines much and many speculate more. Not unfrequently, especially of late, have we been treated with irenic disquisitions as to the location of these rare elements in the natural system. It appears to be forgotten that Mendeleeff used his table to correct the formulas of the typical oxides of certain elements, as, for example, lanthanum (LaO to La_2O_3). The fact is forgotten that the atomic weights, now ascribed, would be materially different were the type different. The ascribed atomic weights are dependent upon the synthesis or analysis of the sulphates almost without exception. It is forgotten that '-yl' salts, like uranyl, chromyl sulphates are possible for these elements, as recently shown by Blandel for titanium and Matignon for praseodidymium and neodidymium. Furthermore, it is forgotten that the sulphate method is absolutely defective, as Schützenberger pointed out. This has been verified by Wyrouboff, Dennis, Brauner and Pavlicek, and Demarçay, as well as myself. Therefore, all attempts to arrange these elements, some of which are known to be complex, in the periodic table are veriest speculation, which can profit little. It is quite as true also that the table should receive no discredit because it fails to account for them with our present knowledge. According to its author the table reserves twenty-three places for their occupancy.

Two desiderata may be mentioned: (1) Satisfactory tests, preferably colorimetric, which may be quickly applied, as Hillebrand has remarked about titanium. This supplied, perhaps these earths would not be so rare. I have shown the universal occurrence of titanium. (2) Spectral data from more highly purified substances, for much that is now at hand has been obtained from impure earths.

The methods of attack at present are mainly based upon the same phenomena of oxidation, reduction and saturation. The applications are different, however. As typical examples, a few may be cited as follows: Melikow has been using the hypochlorites, virtually the Lawrence Smith method; Muthmann, hydrogen dioxide and acetate solutions; Dennis is using organic acids, as did Metzger for thorium; Jefferson and Allen have applied certain organic bases for analytical purposes, while in our laboratory we have saturated the stable alkalies, fused with sodium peroxide, and reduced with such basic reducing agents as hydrazine and phenylhydrazine, and so forth.

All is not dark, for rifts in the clouds are making. Old Watt said: 'Nature has always a weak side, if we can only find it out.' Looking back and with that century of experiences we can frequently in a measure judge of the future and those things which make toward the true end.

Naturally a sequel is due this paper, and I look forward to presenting it in my vice-presidential address before Section C of the American Association at the St. Louis meeting. Some sequels are better than their predecessors; most of them, however, are not so good.

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SCIENTIFIC BOOKS.

Inorganic Chemistry, with the Elements of Physical and Theoretical Chemistry. By J. I. D. HINDS, Ph.D., Professor of Chemistry in the University of Nashville. New York, John Wiley & Son; London, Chapman & Hall, Limited. 1902. Large 8vo. Pp. viii + 566.

Chemistry by Observation, Experiment and Induction. A Laboratory Manual for Students. By J. I. D. HINDS, Ph.D., Professor of Chemistry in the University of Nashville. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 12mo. viii + 192.

Principles of Inorganic Chemistry. By HARRY C. JONES, Associate Professor of Physical Chemistry in the Johns Hopkins University. New York, The Macmillan Company; London, Macmillan & Co., Ltd. 1903. Large 8vo. Pp. xx + 521.

A Text-Book of Inorganic Chemistry. By Dr. A. F. HOLLEMAN, Professor Ordinarius in the University of Groningen, Netherlands. Rendered into English by HERMAN C. COOPER, Ph.D., Instructor in Syracuse University, with the cooperation of the author. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1902. Large 8vo. Pp. viii + 458.

While the number of smaller and introductory text-books on chemistry which have appeared in this country during the past few years is very large, it is a long time since any new work on inorganic chemistry, which aims to be even tolerably complete, has been published. That three such works should appear within a few months of each other is evidence that a need was felt in this field. This is, of course, due to the revolution, as it might well be called, which has taken place in the fundamental conceptions of inorganic chemistry, and the recognition of the fact that these must be utilized in teaching the subject. This was early seen by Ostwald, and he must be considered the pioneer of the new didactic chemistry.

It is interesting to note how the authors before us have utilized the wealth of ma-

terial placed before them by the physical chemists. One is tempted to use a piscatorial metaphor and to affirm that Hinds has nibbled at the bait, Holleman has taken a good hold on the hook, while Jones has swallowed line, sinker and all.

These books are intended for serious college work, but the question must arise as to whether they would be suited for beginners even in college classes. In some of our colleges, most of those entering have had some smattering of chemistry, and a few have had really thorough grounding in the fundamentals of the science in the secondary schools. Yet in most college classes there are those to whom the subject is new. Just now it seems to be the fad to introduce conceptions of physical chemistry into the elementary text-books, and in one recently published the student meets the theories of electrolytic dissociation and of mass action during the first few weeks of study, while descriptive chemistry is relegated to a score or two of pages at the end of the book. In spite of all that has been said to prove that chemistry will never be a true science until it can be treated on a purely mathematical basis, it still remains the writer's opinion that a knowledge of what is sometimes rather superciliously called descriptive chemistry is fundamental to the thorough acquisition of the science of chemistry. Naturally it is not necessary, in gaining a knowledge of descriptive chemistry, to found it upon theories which are false and must be unlearned at a later period; indeed, too much theory is just what is not called for in studying descriptive chemistry. But a student must have some considerable familiarity with chemical elements and compounds and with chemical reactions before he can at all realize the bearing of chemical theories.

On the other hand, college students are supposed to have a certain maturity and development of mind, which should enable them to handle a subject in a very different manner from students of secondary schools. Theoretically a purely inductive method may be the most scientific, but practically the average college student will weary of following the arguments of a well-developed course of reasoning three or four weeks long, and he will lose his interest. If a partially deductive method be used, if certain of the more prominent lines of the fundamental theories are sketched before him, he sees something of the import of the phenomena he is studying, much to his pleasure and his interest. This appears to be clearly recognized by the authors of the books before us.

In Professor Hinds' 'Inorganic Chemistry' this idea is apparently carried to an extreme, for the whole of the theoretical matter is presented before descriptive chemistry is touched upon, but in this respect the book is not quite so extreme as it seems at first sight, for in the preface the author advises that the book is not intended to be studied consecutively, but lessons are to be taken alternately from the two portions. He suggests a definite order, which, however, any teacher may change to suit his own ideas. In this respect the book takes on somewhat the character of an encyclopedia, where each user may formulate his own logical system for himself. A system, this, which presents some advantages, but also some drawbacks.

This book is divided into four parts: 'Introduction,' 'Physical Chemistry,' 'Theoretical Chemistry' and 'Descriptive Chemistry,' and the third part has two divisions—'Statics' and 'Dynamics.'

The Introduction is brief and contains a short outline of the atomic theory and a description of the various divisions of chemistry.

Part II. is a review of those portions of physics which have a more or less direct bearing on chemistry, with a few pages on crystallography. The chapter on 'Interaction of Solids, Liquids and Gases' is perhaps the most unsatisfactory one in the book. Osmotic pressure is not even alluded to and the treatment of solutions is very inadequate; indeed, the whole chapter might have been written fifty years ago. The chapter on 'Changes of Physical State' is more modern and more satisfactory.

Under the head of 'Statics' we have a discussion of atoms and molecules and their properties, including the classification of atoms, valence, acids, bases and salts, nomen-

clature and some pages on formula writing and structural formulæ. The division on 'Dynamics' includes the chapters 'Chemical Actions,' 'Thermochemistry' and 'Chemical Calculations.' In the first, dissociation, ionization and the law of mass action are taken up. One can not help feeling that these sections are, as it were, dragged in, rather than that they form an integral part of the subject of which the book treats. This is especially the case when one finds, in close contiguity, the following, under the caption of superior chemical attraction as a cause of reactions: 'In the following, $HgCl_2 + 2KI = HgI_2 + 2KCl$, the K leaves the I and takes the Cl from the Hg, and the Hg and I, being set free together, unite.' Altogether, these first hundred pages or so of the book give little evidence of the advances that chemistry has made in recent years. Perhaps this would appear less conspicuous if the material were scattered through the book, as the author recommends when using the book for didactic purposes.

The remainder, some four fifths, of the book is taken up with 'Descriptive Chemistry.' The treatment of this subject is much more satisfactory. It is full enough for college classes, a good sense of proportion is observed in the amount of space devoted to the different elements and compounds, errors of statement and of typography are rare, and the material is brought well down to date. A considerable number of experimental illustrations are described, which would serve well for lecture or laboratory. The general arrangement of the elements is according to the periodic system, beginning with hydrogen and the inert gases of the eighth group, and then proceeding in order from the seventh group to the first, concluding with the metals of the eighth group. This order is occasionally departed from, as in the treatment of manganese in close connection with iron, and in discussing the atmosphere and combustion immediately after the carbon group. Thulium is placed with the halogens, samarium with manganese, and gadolinium between silver and gold, but as only a few lines are given to these rare elements, little harm is done. The nomenclature of the groups, though not absolutely new, is new enough to appear strange, for the halogens appear under the chloroids, group VI. is treated in the two divisions of the sulfoids and the chromoids, the inert gases under the heloids, etc.

For all those teachers—and they are many—who believe that the newer conceptions of physical chemistry should be reserved for students more or less advanced in general chemistry, Professor Hinds' book will be found an excellent text-book for a thorough course in inorganic chemistry.

'Chemistry by Observation, Experiment and Induction' is a laboratory manual prepared to accompany Hinds' 'Inorganic Chemistry.' The essential feature of the book is that under each experiment a series of questions is given, with spaces in which answers are to be written. The experiments are simple and well chosen. No quantitative experiments are introduced, but there is a considerable number of problems.

In both of the books the revised spelling is used.

If Dr. Hinds almost ignores in his book the newer physical chemistry, Dr. Jones goes to the opposite extreme in his 'Principles of Inorganic Chemistry,' and the book appears almost like a treatise on physical chemistry, copiously illustrated from inorganic chemistry. Yet all the essentials of inorganic descriptive chemistry are here, but viewed from the standpoint of physical chemistry. This book must be considered the most notable contribution to didactic chemistry produced by an American since the appearance of the Remsen series of text-books.

We have here a conscientious attempt to teach general chemistry purely from the standpoint of the newer chemical conceptions, and it doubtless gives us a little forecast of what will be the character of the chemical teaching of the future. The book, however, shows the dogmatic spirit which is characteristic of many of the physical chemists of to-day. Not only are the old ideas looked upon as completely overthrown, and their adherents as antiquated—this might be condoned—but the newer theories are treated as if in them the last words in chemistry have been uttered.

This tone is illustrated by a single quotation from the book before us: "The highest aim of scientific investigation is the discovery of wide-reaching relations between large numbers of facts. Such relations when sufficiently comprehensive are known as generalizations. *Beyond these we can not go*" (italics ours). A very considerable proportion of the studies of these physical chemists center around the theory of electrolytic dissociation, and this theory is invoked to explain practically all the phenomena of chemistry. Speaking of the fact that perfectly dry sodium does not react with perfectly dry sulfuric acid, Dr. Jones tells us that 'in terms of the theory of electrolytic dissociation and catalysis these facts are just what would be expected, and could have been predicted before they were discovered.' Ostwald shows that in the light of this theory all the reactions and procedures of analytical chemistry become simple and clear. On the other hand, we must remember that the theory itself applies with strictness, as far as it concerns solutions, to those solutions only which are at great dilutions, indeed in many cases to those of such dilutions as to be practically unattainable. The theory may be invoked to explain the phenomena of concentrated solutions, multitudinous reactions of organic chemistry, reactions which take place at high temperatures, and many others, but in these fields the applicability of the theory is largely a matter of conjecture. In other words, the theory of electrolytic dissociation is not the great, universal generalization we might imagine from the writings of some of its adherents. It represents a truth, but by no means the whole truth. In certain fields, as notably that of analytical chemistry, it is exceedingly useful, though even here it by no means explains everything. It does clear up many points which were formerly obscure. One can not help sometimes wondering if it is not leading chemistry fully as much back to the views of Berzelius, as carrying it forward into new fields, and whether it may not, like the dualism of the great Swede, some near day meet its Dumas. But even should this be the case, the work of the school of modern physical chemists is of inestimable value, and will always stand as one of the greatest advances in the development of chemistry. The dualistic theory of Berzelius was, after all, never really overthrown, but lives to-day in the theory of electrolytic dissociation. The mistake of Berzelius was in believing it applicable to all chemical phenomena. The physical chemist of to-day has found a key which fits many locks hitherto inviolable, but it has not yet proved itself to be the master-key.

In the preface to his book Dr. Jones says: "The aim of this book is to add to the older generalizations those recently discovered, and to apply them to the phenomena of inorganic chemistry in such a way that they may form an integral part of the subject, and at the same time be intelligible to the student. Why should we continue to teach the chemistry of atoms to students on the ground of its being a little simpler, perhaps, than the chemistry of ions, or on any other ground, if we know that it is not in accordance with the recently discovered facts? Or why should we continue to teach purely descriptive chemistry when the science of chemistry has outgrown this stage, and many of the most important relations have been accurately formulated in terms of the simpler mathematics? * * * If a student can grasp the conception of an atom and can not add to this the idea of the atom carrying an electrical charge, his hope of ever learning anything of chemical phenomena in general is not bright. * * * Why should chemists be hampered by being compelled to describe phenomena at length when these could be formulated in a single line? The time has come when they need not be, and the earlier elementary mathematics is introduced into textbooks on chemistry, the better for chemistry and for the chemist."

While thoroughly carrying out the spirit of the preface, the book is not, perhaps, as radical as might be expected. After opening with an introduction on elements and compounds and a chapter on the great generalizations of chemistry—the laws of conservation of mass, of constant proportion, of multiple proportions, of combining weights, the atomic theory and the correlation and conservation of

energy—an exhaustive study of oxygen is taken up, introducing the subjects of combustion, thermo-chemistry, the laws of Boyle and Gay-Lussac, absolute zero, liquefaction of gases, and closing with the experimental demonstration of the statement that 'the real difference in the properties of oxygen and ozone is due to the different amounts of intrinsic energy present in their molecules.'

The next chapter, on hydrogen and water, leads to the phase rule and electrolytic dissociation. The following chapters on determination of atomic and molecular weights contain also dissociation, the law of mass action, and the freezing and boiling point methods. Next comes an important chapter on osmotic pressure and the theory of electrolytic dissociation, written with excellent clearness. The conductivity method is here described. A chapter on chlorin brings up the conception of acids, of valence and Faraday's law. The subject of valence, or valency as the author calls it, has evidently been a difficult one to deal with. There is clearly an effort to confine valence solely to the ions, and structural formulæ are completely tabooed throughout the book. It would be rather rash to cut loose from structural formulæ in organic chemistry, but if they represent a truth in one field, they represent a similar truth in the other. It is true that structural formulæ have been fearfully misused and abused in inorganic chemistry, but this is no reason for completely abandoning their use and confining valence to the ion alone. The author is quite consistent, but he has thrown away a useful piece of scaffolding before the walls of his building are complete.

The periodic system is the next topic, and is well treated. We can not help thinking that some of the imperfections which the author finds would disappear if Venable's modification of the table were used. This is particularly true of the difficulty in making sodium a member of the copper, silver, gold group, and that of grouping fluorin with manganese instead of with the halogens, where it evidently belongs.

From this point on, the elements are studied in the order indicated by the periodic table. The other halogens are followed by sulfur, under which the temperature-pressure diagram is considered, and, in connection with hydrogen sulfid, reversible reactions. After nitrogen comes a chapter on neutralization of acids and bases, and another on the atmospheric air, including the inert gases. Under carbon dioxid we find a discussion of critical temperature and the continuity of the liquid and gaseous states, as well as a brief outline of the kinetic theory of liquids. The section on the rôle of carbon in producing light is particularly good.

After completing the metalloids (the author uses this term very sparingly, and the term non-metals not at all, as far as we have noticed), the metals are taken up, beginning with those of the alkalies. The purification of sodium chlorid gives occasion for a consideration of the application of the law of mass action to ions, and the sodium halids are used to show the transition point on their solubility curves. The phase rule finds a good illustration in the dissociation of calcium carbonate. Under zinc is an extended discussion of primary batteries and solution tension. That the book does not overlook practical applications of the subject is evidenced by nearly two pages on phosphate fertilizers and their analysis, and by a clear, if brief, treatment of iron and steel manufacture. Iron also leads to a consideration of oxidation as a method of ion formation, and of chemical action at a distance. Change of color with change in electrical charge is exemplified by the iron cyanids, and the color of ions by the permanganates. Under uranium, radio-activity is taken up, and under copper, ion formation in substitution reactions. Photography is outlined under silver; gold furnishes an example of ion formation from contact of molecules and also of colloidal solutions. This last subject is more fully taken up under platinum, where the work of Bredig is noticed.

We have thus gone rather minutely over the contents of the book because it represents somewhat of a pioneer attempt to treat inorganic chemistry from the standpoint of physical chemistry, and this necessitates presenting a pretty full outline of physical chemistry

itself. The attempt is interesting and, we must admit, very successful. The only serious omission we note is that of double and complex salts. There is a brief reference to the double mercuric iodids, a paragraph on alums, some discussion of double cyanids and chloroplatinates, but no consideration of double salts from a theoretic standpoint nor any mention of Werner's hypothesis. When one considers the number, variety and importance of double salts, he can not but feel that this omission is a defect in a book of this scope.

The book will be interesting and profitable reading for every teacher of chemistry, nor should any advanced student of chemistry fail to go carefully through it. It will be particularly valuable for those teachers whose student days were before the reign of the present physical chemists. How the book will fare as a text-book remains to be proven. In the judgment of the reviewer it would make a hard task for a beginner and should only be used for students who have a considerable knowledge of descriptive chemistry. With this view, however, the author of the book evidently differs.

The book is well gotten up, the type is clear, and the proof-reading has been almost perfectly done; the illustrations, though not numerous, are mostly new and really illustrative, and the book closes with a copious index. One other commendation must not be omitted. The style of the author is excellent. It is clear, never heavy, and at times almost conversational. This makes the book easy reading. Some may object to the author's enthusiasm; we do not. We like to read of the 'beautiful investigations' of Moissan with the electric furnace, we like to hear Wöhler called the 'great' German chemist, and we appreciate a book the better whose author is not so much engrossed with theory but that he can close its pages with the words, speaking of magnesium plato-cyanid: 'It is questionable whether another compound of equal beauty is known in the whole field of chemistry.'

The last book before us, that of Professor Holleman, of the University of Groningen, was first published in 1898, and two years later a German translation appeared. The English translation has the further advantage of having been completely revised by the author, so that it is practically a revised edition.

This book bears in many respects a marked resemblance to that of Dr. Jones, so much so, indeed, that it would be superfluous to give an extended review of it. The aims and the scope of the books are the same, the methods used are similar, and the order in which the different subjects are taken up does not differ materially. Holleman's book lacks wholly the dogmatic atmosphere we have noticed in that of Jones, but it also lacks the enthusiasm of the latter, although it is very readable. Holleman treats the principles of physical chemistry rather more fully than Jones, and he introduces more mathematics, though the mathematics used is always elementary. It seems as if this makes the subject matter simpler and clearer, but many may think otherwise. Holleman is also fuller in his treatment of subjects connected with practical and technical chemistry. Taken altogether, it is impossible for the reviewer to decide which book would probably prove more successful in the class room, but both will prove very helpful to a teacher.

There is not quite the same freedom from errors that is found in Jones's, and it is occasionally evident that the book was not originally written with reference to use in America. This is particularly true in some cases of metallurgical practice. The translation is exceedingly well done, and does not read like a translation, though now and then expressions creep in which reveal the fact, as well as others which are English rather than American. For example: 'it is not supplied with a steam pipe either'; 'ferric hydrate serves as a counter-irritant' (for arsenic); 'silicon trichloride is obtained as a side-product'; 'SnS falls down as a powder'; 'SnS_2 falls out as a powder'; 'it (minium) has a pretty red color'; 'soda crystals weather,' and efflorescence seems invariably to be spoken of as weathering; 'having very different properties than liquids,' and 'than' is frequently used after 'different'; 'axles of railway carriages'; 'metallic crustations'; 'it dissolves without

generating scarcely any chlorin'; titanium, zirconium and thorium are spoken of as 'uncommon' elements.

But if these are the worst criticisms that can be passed upon the book, and this is perhaps the case, it must be conceded that both author and translator have done their work in a very satisfactory manner, and we have no doubt but that Holleman, as well as Jones, will find its way into many class-rooms and will also prove to be but a pioneer of an improved type of text-book, which will revolutionize the teaching of inorganic chemistry. And for this let us be devoutly thankful.

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WASHINGTON AND LEE UNIVERSITY.

A Text-book of Zoology. By G. P. MUDGE. London, Edward Arnold. 1901. Pp. viii + 416.

The author of this book is lecturer on biology at the London School of Medicine for Women, and on zoology and botany at the Polytechnic Institute, Regent Street, and is also demonstrator in biology at the London Hospital Medical College. His text-book may, therefore, be presumed to be an expression of the practice of an experienced and active teacher of biology. It differs markedly in matter and arrangement from the usual zoological texts, arranged systematically, that is, according to the accepted classification of animals. In a first part are an interesting introduction called 'the scope of biology' and a brief statement of 'the characters of the great divisions of the animal kingdom,' in which Protozoa, Metazoa, Acœlomata, Cœlomata, Vertebrata, Invertebrata, Diploblastica and Tripoblastica are defined. Then comes a second part given to a study of 'the comparative morphology of the organs of *Scyllium, Rana* and *Lepus*.' The organs of these three vertebrates are discussed on the plan of the comparative anatomist, the condition of each organ or system of organs being compared in the three forms. This discussion covers one hundred and sixty-seven pages, and is illustrated by fifty-two diagrammatic figures. To this part is added a chapter of twenty-two pages on the morphology of *Amphioxus*. A third part, of sixty-eight pages, is given to the morphology of four cœlomate invertebrates, viz., *Astacus, Periplaneta, Anodonta* and *Lumbricus*, the treatment being again that of the comparative anatomist. Then comes a chapter on 'the morphology of *Hydra*,' an acœlomate invertebrate, and a chapter on 'the morphology of *Paramœcium* and *Amœba*.' The fourth part of the book is composed of a chapter on 'embryology' (38 pp.), one on 'the life history of the cockroach and the butterfly, and their chief structural differences' (9 pp.), one on 'karyokinesis, oogenesis and spermatogenesis, maturation and impregnation of the eggs, and parthenogenesis' (10 pp.)!—the author is seeing the limits of his permitted space; then one on 'heredity' (26 pp.), and finally one on 'variation' (15 pp.).

When one departs from the usual and presumably approved manner of make-up of zoological text-books, the real court of appeal for the final decision as to the worth of the new manner is that composed of teachers who have tested in actual class work the usefulness and practicalness of the innovation. Thus does the reviewer easily put aside the necessity of expressing an opinion about the matter. He will hazard the guess, however, that most present-day teachers of zoology will not choose a text-book of comparative anatomy under the name of a text-book of zoology for their first-year classes.

The work outlined in the book is sound and thorough, and the discussions of heredity, variation and the scope of biology are modern and interesting. The book is compact, well-made and fully indexed. V. L. KELLOGG.

Lehrbuch der Zoologie. By ALEX. GOETTE. Leipzig, Wilh. Engelmann. 1902. Pp. 504; 512 figs.

The author of this zoological text-book is professor of zoology in the University of Strassburg. The book is intended for university classes; it is of the reference or manual of classification type of text-book, not of the laboratory guide or specifically outlined course type, as is the English text-book reviewed above. After twenty-five pages of introduc-

tion, defining homology, analogy, etc., and describing protoplasm, the cell, etc., and mentioning some names and dates in the history of zoology, the rest of the book is arranged according to the present classification of animals, beginning with the Protozoa, and systematically discussing systematic zoology with orders and sometimes suborders for units. The systematic consideration of the Metazoa is preceded by a fifty-page discussion of the tissues, organs and development of the many-celled body.

Where all animals are touched on none can be adequately considered. Text-books of zoology which get in the name of every order of living animals are misnamed; they are dictionaries of systematic zoology, catalogues of the animal kingdom. The beetles, of which there are 12,000 known species in North America—and how many thousand in the world?—with a variety of form and habit comparable in extent with that of the endless pattern pictures of a busily handled kaleidoscope, get one page and one figure of this book. Three fourths of this page are given to dividing beetles into four suborders. Why not make it one line, and be more truly and just as effectively a catalogue and less a pretense of being something else? The rest of the page could then go to the needed expansion of the account of the special structure and physiology of the class of insects. The student who is going to study beetles beyond the name Coleoptera has no possible use for one page and a subdivision into four suborders. He must have thirty pages and half of the families if he is to go a single step forward in their systematic study, or as many pages as he can have, with no subdivision, if he is to get a glimpse of their life and habits. The author, in trying to get all the animals catalogued in his 'Lehrbuch,' makes of it no text-book at all, and a sort of catalogue vastly inferior to a professed synopsis like Leunis's.

V. L. Kellogg.

L'Hypnotisme et la Suggestion par le Dr. Grasset. Paris, Octave Doin. 1903. 8vo. Pp. 534.

The culmination point of the contributions to the literature of hypnotism was reached quite a number of years ago. There was a period when the contributions to this topic quite overshadowed those to any other division of abnormal psychology. Dessoir issued in 1890 a supplement to his bibliography of hypnotism first issued in 1888, and recorded nearly four hundred titles to the credit of these two years.* The more recent contributions that have been comprehensive in scope have likewise been more selective in purpose. Some have been devoted to the analysis and description of the psychology of suggestion; others to the therapeutic applications; others to the analogies between that and other states normal and abnormal. As a number of the International Library of Experimental Psychology now appearing in fifty volumes under the editorship of Dr. Toulouse, there has appeared a volume on 'Hypnotism and Suggestion,' of which the author is Dr. Grasset, of the University of Montpelier. As the representative of this library, the volume on hypnotism will command wider attention than would be accorded it as an independent contribution.

It can not be said that the volume, though it compares favorably enough with many others that have appeared, really adds much of note or illumination to the present status of the subject. It does, indeed, bring forward with a fair sense of their relative importance the several problems that are most worthy of attention in contemporary psychology. It wisely dispenses with much introductory or historical matter, which in former compends found a somewhat undue place. It recognizes that the fundamental problem, the

* Beginning with 1896, the number of entries for this group of topics in the 'Psychological Index' is 51, 84, 154, 143, 77, 35, 35, 28. These numbers are not comparable, since the falling off in the more recent years is in part due to a subdivision of the topics that bring 'Hypnotism' into a separate division in the later but not in the earlier years. Parallel with this, there is some widening of the scope of the 'Index' since its foundation. None the less, the 'Index' shows the general falling off in the productiveness of this topic. Such falling off is a welcome consummation, so far as it represents the cessation of wordy and unorganized—not to say amateur—contributions.

solution of which will determine the status of hypnotism, of suggestion and of other varieties of mental states, is the problem of the subconscious and its relation to the ordinary form of mental action. Dr. Grasset's solution of this problem, or rather his attitude towards it, is not helpful. His discussion thereof is more like a logomachy than a psychological analysis, and his use of his favorite diagram decidedly illogical. He accepts the hypothesis, now current in such diverse forms, of two separate forms or types of psychic expression; by the letter *O* he designates the superior form of psychic action or the highest center; the *O* stands at the apex, and dependent thereon and with connections between them, are the members of the group of inferior psychic centers arranged in the form of a polygon. By this painfully artificial representation the words 'polygonal' and 'suspolygonal' become synonymous with subconscious and subvoluntary sources of action. We read of the 'dissociation of the polygon' of the individual, of 'polygonal spontaneity,' of 'polygonal patients or maladies' and other confusing and absurd expressions. This type of logicality is hardly pedagogical. It must also be added that the author's attitude towards many other questions of fact and interpretation are far from commendable. His reference to the independence of the action of the two hemispheres of the brain as proven by the phenomena of hypnosis, and his acceptance of questionable hypotheses in regard to the nervous substrata of hypnotic behavior, are instances in point. His entertainment of the hypothesis of telepathy and clairvoyance —though he believes that neither of these is proven—suggests weakness of grasp of their status, rather than judicial toleration.

The author's main positions are these: that there is a real hypnotic state, distinct from suggestion, marked by independent physical signs as well as by increased suggestibility; that the source of this state is in the dissociation or disaggregation of the subconscious psychic mechanism; that though normally the higher and lower psychic centers act in complexly coordinated, unified manner, in abnormal states—of which hypnosis is one great type—they act separately; that hypnosis does not present sufficient analogies to sleep or to any normal mental state to be affiliated with it or interpreted by it; that a significance may be given to spiritistic or mediumistic phenomena analogous to the various states and types of hypnosis; that the phenomena of normal suggestion, which in the conception of the Nancy school is made almost synonymous with the acquisition of ideas, are not truly analogous to the increased suggestibility characteristic of the true hypnosis. These are all debatable positions that yet await a more competent master to set forth their bearing and value for experimental psychology. Dr. Grasset contributes something of value to the consideration of these positions, but not what one has a right to expect of a volume that is presented as authoritative in character. It only remains to add that there are the usual chapters upon the medical and legal aspects of hypnotism, and interesting, though somewhat prolix and not properly systematized presentation of the facts of hypnotism, and a better index than the average of French books offers. It is to be hoped that the further volumes of this series, the contributors to which include a few American names, will meet a higher standard. The ten volumes already published give the impression of very unequal care in their preparation and merit in their authors. Some of the volumes are distinctly commendable. May the rest prove to be so!

J. J.

SCIENTIFIC JOURNALS AND ARTICLES.

The Plant World for April contains the fifth of the 'Extracts from the Note-Book of a Naturalist on the Island of Guam,' by W. E. Safford. 'Monocotyledons or Dicotyledons,' by J. Arthur Harris, calls attention to the fact that there are some plants whose position in this respect is very puzzling, and briefly discusses the question which of the two forms is the older. George V. Nash describes 'The Palm Collection at the New York Botanical Garden,' and there is much of interest in the section on 'The Home Garden and Greenhouse.'

Bird Lore for March–April has the story of 'A Sierra Nighthawk Family,' by Florence M. Bailey, and of 'A Family of Barn Owls,' by Thomas H. Jackson; an important brief article on 'The Heath Hen in New Jersey.' Anna Head describes the 'Nesting of the Ruby-crowned Kinglet' and Frank M. Chapman gives the third paper on 'How to Study Birds,' this being devoted to the nesting season. There is the third series of portraits of *Bird Lore's* Advisory Councilors. There are the customary notes, reviews and reports of the Audubon Societies, from which we learn of the spread of bird protection in various states.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 567th meeting was held on April 11, 1903. Professor Marvin exhibited a seismograph sheet showing a slight earthquake wave on March 15. Professor Gore described the 'International Bibliography of Mathematics' now published at irregular intervals in card form. Thus far eleven sets of one hundred cards each have been published.

Professor T. J. J. See, U. S. Navy, read a 'Historical Sketch of Olaus Roemer, the Discoverer of the Velocity of Light.' Roemer was one of the greatest scientific geniuses, ranking with Aristarchus of Samos, Archimedes and Hipparchus, among the ancients, and with Galileo, Newton and Bessel, among the moderns. As almost all of his observations were consumed in the conflagration which destroyed a large part of Copenhagen in the year 1728, his memory has been greatly neglected. Yet it was Roemer who invented all the principal instruments of the modern observatory—the meridian circle, the prime vertical, the altazimuth and the equatorial telescope. He lived very much in advance of his age.

The discovery of the velocity of light in 1675 was treated at length. It was made from the eclipses of the first satellite of Jupiter. Most of Roemer's contemporaries rejected his theory of the finite velocity of light, or adopted it only after long years had elapsed. The French men of science were slower in accepting the new idea than men of science in other nations. Huygens and Newton adopted Roemer's results, while Fontenelle, the perpetual secretary of the Paris Academy of Sciences had even gone so far as publicly to congratulate himself on escaping the seductive error of believing in the gradual propagation of light! Roemer gave eleven minutes for the equation of light (time in coming from the sun to the earth), but Newton reduced the value to between seven and eight minutes. The true value found by the classic researches of Michelson and Newcomb is about 8.4 minutes, to which Newton's was a close approximation.

The speaker said that with the exception of the discovery of the law of gravitation, no sublimer discovery than that of the velocity of light had ever been made. Notwithstanding the incredulty of others, Roemer had never wavered in his belief in this discovery, and the speaker said that it paved the way for the investigation of the velocity of electricity, which had been found with much accuracy.

Roemer was born in 1644 and died in 1710, all of his life except nine years being spent in Denmark. He met Picard when he came to Denmark to determine the position of Tycho Brahé's Observatory in 1671, and the following year returned with him as his assistant, and spent nine years at the Paris Observatory, just started under J. D. Cassini. Picard was much the best astronomer of his age, but had been set aside by the government of Louis XIV., and a foreigner, Cassini of Bologna, called to be superintendent of the Royal Observatory at Paris. This circumstance injured astronomy in France for many years. Roemer's association with Picard was fortunate, as this gave him the best ideas of the times, though his own genius was even greater than that of Picard, who had acquired an imperishable reputation by measuring the arc of the meridian used by Newton for verifying the theory of universal gravitation in 1685.

A picture of Roemer was exhibited, kindly sent by Professor T. N. Thiele, director of the Royal Observatory of Copenhagen. This showed a striking resemblance to Newton.

The paper will be published in an early number of *Popular Astronomy*.

Dr. A. L. Day, of the Geological Survey, discussed 'The Melting Point of a Glass,' basing his remarks on a study of borax glass, which has a melting point in the neighborhood of 730° as determined in ordinary ways. If ordinary solid bodies have heat communicated to them the temperature gradually rises till melting begins, when it remains stationary till melting is complete; and a corresponding phenomenon takes place on cooling from liquid to solid. So the curve of temperature as a function of the time shows a portion parallel to the axis of the time. The borax glass, if in the crystalline state, shows a similar straight portion, or at least a departure from the smooth curve; but if in the vitreous stage the curve may be perfectly smooth, and the material pass from liquid to solid without showing any phenomena by which to fix a melting point, as ordinarily defined.

THE 568th meeting was held April 25, 1903, in the rooms of the National Bureau of Standards through the courtesy of Director S. W. Stratton. No formal papers were presented, but the laboratories and shops were opened, and many new instruments were exhibited and explained informally. The evening was one of great interest to all visitors.

CHARLES K. WEAD,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 371st meeting of the society was held on Saturday, April 18.

W. J. Spillman spoke on 'Agrostological Problems in the United States,' using a number of lantern slides by way of illustration. These slides were prepared from the recent census reports, and showed the distribution of each of the important hay and forage crops over the country. He brought out the rather remarkable fact that by far the larger part of the hay and forage produced in this country is produced on the glacial drift, also that one fourth of the total hay and forage is produced from wild grasses, and that of the wild grasses that are thus utilized no one of them has as yet been brought into cultivation. The principal reason for this lies in the poor seed habits of these grasses, a fact which renders their use impracticable. He also gave some illustrations of the relation between certain crops and certain geological formations. It was shown that, in the state of Kentucky, Kentucky blue grass (*Poa pratensis*) is confined to a circular area in the northern part of the state, in which the dolomitic limestones of the Silurian outcrop. In a similar manner Johnson grass in the southern states is more or less closely confined to the soils of the Cretaceous. He pointed out the importance of increasing the areas of hay and forage crops, particularly in the cotton belt, where the system of farming has depleted the soil of humus to such an extent as greatly to interfere with its productivity. He stated that another very important problem was to secure suitable crops for the arid and semi-arid regions that could be grown without irrigation, and that some progress has been made in this direction.

A paper by Basil Dutcher, captain U. S. Army (Medical Corps), on the 'Mammals of Mount Katahdin,' was read by Vernon Bailey. The topography of the region was carefully described, and this was followed by a fully annotated list of the mammals. Of the larger species the moose was fairly common, the Virginia deer abundant, while the otter and lynx were still found in the vicinity. Small carnivores, the fishes, mink and weasel were said to be common, but Mr. Dutcher was able to trap but few small rodents, the only really abundant rodent being the muskrat. The fauna was that of the Canadian region, and not that of the Hudsonian.

In his paper, entitled 'Notes on the Dissemination of *Sedum douglasii* by Proliferous Shoots,' Mr. V. K. Chesnut drew attention to a comparatively undescribed natural method of plant reproduction. *Sedum douglasii,* a plant growing at an altitude of about 7,000 feet in Montana, forms axillary branches about a half inch long, which, late in the summer, become detached from the dried stem after the plant has flowered, and which are capable of reproducing the plant vegetatively. The light, spear-shaped branches

are blown about by the wind, remain dormant under the snow through the long winter season, and, if the proper conditions are present, take root in the soil the following spring. The mechanical structure of the shoots which enables the plant thus to disseminate and to perpetuate the species was described and illustrated by specimens and by photographs.

F. A. Lucas.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

At the 142d meeting of the society, held in the assembly hall of the Cosmos Club, Wednesday evening, April 8, 1903, the following program was presented:

Mr. J. E. Spurr, 'The Relation of Faults to Topography.'

Folds and faults are closely associated genetically, and their effect on the surface relief is analogous. Each may be divided into three orders:

1. Those affecting great areas, as portions of continents.
2. Those affecting broad belts, producing mountain systems.
3. Folds and faults proper, being wrinkles and fractures on the grander flexures and displacements of the first and second orders.

Gravity antagonizes these disturbances, in so far as they affect surface relief. On account of the relative bulk of material to be readjusted, and for other reasons, erosion is generally ineffective in combating flexures and dislocations of the first and second orders, while folds and faults proper are generally overcome. So the anticlinal ridge and the synclinal valley of direct deformation are relatively rare as compared with the anticlinal ridge, the synclinal ridge and the anticlinal valley of erosion. Similarly, the speaker's studies have convinced him that the analogous features of relief connected with faults have about the same proportion. Simple fault-scarps (analogous to ridges and valleys of direct deformation) are relatively rare; while normal erosion fault scarps and reversed erosion fault scarps (analogous to anticlinal and synclinal ridges of erosion) are about equally abundant. The forms *indirectly* expressed on the topography by the erosion of folded and faulted rocks also differ in different climates.

Mr. Waldemar Lindgren, 'Metallic Sulphides from Steamboat Springs, Nevada.'

During a visit to Steamboat Springs in 1901, it was found that a shaft forty feet deep had been sunk through the sinter deposits near the railroad station. Below the sinter, a gravel of well-rounded granitic and andesitic pebbles was found, and in this gravel, which is probably an older deposit of Steamboat Creek, minute needles of well-crystallized stibnite were found to be very abundant. The gravel also contains well-crystallized pyrite, and some opal often coats the surface of the pebbles. From the investigations of Dr. Becker it is known that the sinters contain sulphides of arsenic and antimony, but no well defined or crystallized minerals corresponding to these salts have previously been found. Since the gravels in which the crystallized stibnite and pyrite occur seem to be free from the sulphide of arsenic which is found in the overlying sinters, it is inferred that the conditions of deposition in the two cases are different.

Mr. Geo. I. Adams, 'Origin of Bedded Breccias in Northern Arkansas.'

The fracturing and brecciation in the northern Arkansas zinc and lead district are probably due to stresses induced at the time of the folding in the Ouachita Mountain and Arkansas valley regions. At the close of the Carboniferous period the thick mass of sediments which had accumulated in what is now central Arkansas and western Indian Territory was deformed in a manner which suggests that the beds were thrust to the northward. In the Ouachita Mountains there are close folds and thrust faults; in the Arkansas valley region, open folds. In the southern border of the Ozark region, and particularly in the zinc and lead district of northern Arkansas, the generally horizontal position of the rocks was retained, but there was considerable movement of individual beds, especially in the Ordovician series. The variation in the structure of the Ordovician dolomites, which are in places massively bedded and in other places thin-bedded, lamin-

ated and even shaly, resulted in the lateral movement being taken up in varying degree by the individual beds, so that the motion was such as is produced by forces acting in couples. The brecciation is due to the tendency of the pieces, resulting from the breaking of certain brittle strata, to shear past each other, or to rotate with the horizontal movements of the adjacent beds, so that the fragments are relatively displaced.

Mr. E. C. Eckel, 'Dahlonega Mining District, Georgia.'

The country rocks in the Dahlonega district in Georgia are mica schists and gneisses of pre-Cambrian age, including possibly some metamorphosed Paleozoic. These early rocks are cut by diorites and granites; the former highly sheared, the latter but slightly gneissoid. The gold-bearing quartz veins occur along the contacts of the diorites or granites with the mica schists. The veins show but little deformation, and the epoch of vein formation, as well as of the intrusion of the granites, is therefore thought to be not earlier than the Ordovician. This view is confirmed by the occurrence of gold veins in the Ocoee (Cambro-Silurian) rocks of Georgia and Tennessee, and in Ordovician rocks in New York.

W. C. MENDENHALL,
Secretary.

NEW YORK ACADEMY OF SCIENCE. SECTION OF GEOLOGY AND MINERALOGY.

A REGULAR meeting of the Section of Geology and Mineralogy was held at the American Museum of Natural History on the evening of March 16. In the absence of Professor Kemp, Dr. Julien was made temporary chairman.

The first paper was by Dr. A. W. Grabau on the 'Geology of Becraft Mountain, New York.' Becraft Mountain, in Columbia Co., N. Y., is an outlier of the Helderberg Mountains. Its base is formed by the upturned and eroded rocks of the Hudson Group, chiefly the Norman's Kill shales. Unconformably upon this rests the upper part of the Manlius limestone, followed in turn by the members of the New York Devonian up to and including the Onondaga limestone. The structure of the eastern and southern portion of the mountain, which is of the Appalachian type, was discussed, and the excessive folding and faulting upon it illustrated by maps and sections. The paper was discussed by Dr. Stevenson and by Dr. Julien.

The second paper, by Mr. C. W. Dickson, was entitled 'The Mineralogy and Geology of the Sudbury Ontario Copper Nickel Deposits.'

It was shown that by magnetic concentration of the ore nearly all the nickel can be eliminated from the pyrrhotite, proving that the element is present in a separate mineral and that it does not replace part of the iron of the pyrrhotite isomorphously. The economic concentration of the nickel by magnetic methods is, however, practically impossible. The composition of the nickel mineral corresponds closely to that of pentlandite, but there is always an excess of (Fe + Ni) over that required by the formula (Fe + Ni)S in the proportion 11:10.

After studying the relations of the ore and rock minerals in the field and by the aid of the microscope, the conclusion was reached that the deposits are replacements along crushed zones through which the mineral-bearing waters circulated, and that they can not be original magmatic segregations, as generally held.

GEORGE I. FINLAY,
Secretary pro tem.

ELISHA MITCHELL SCIENTIFIC SOCIETY.

THE 148th meeting was held in the chemical lecture room, University of North Carolina, April 14, 7:45 P.M.

The following papers were read:

'The Prices of Anthracite Coal in the United States, 1850–1902,' by Professor C. L. Raper.

'Habits of North Carolina Woodpeckers,' by Mr. Ivey F. Lewis.

'Note on Imaginary Roots of a Cubic,' by Professor Wm. Cain. Certain characteristics of the graphs of functions of the third degree were established and easy tests found (not

involving the discriminant) to ascertain when cubic equations had imaginary roots.

Chas. Baskerville,
Secretary.

DISCUSSION AND CORRESPONDENCE.

ECOLOGY.

To the Editor of Science: I read with much interest Professor Fernow's article, bearing the above caption, in Science, April 17, an article attractively written and containing many valuable suggestions.

I do not propose to enter into the general discussion outlined by the author, but shall confine myself to the paragraphs on the soil. It would not be right to allow so misleading a statement as 'it is first of all to be considered that chemical constitution [of the soil] plays probably only a small part or practically none; the reliance of tree growth on mineral constituents being relatively small' to go without protest.

The chief fact that is adduced in support of this dictum rests on the small percentage of ash in the grown tree and its greater abundance in the leaves and younger growth.

The growth of a tree is as absolutely conditioned by 'mineral constituents' as by any other fundamental factor of the environment. Vines says: 'Thus the inorganic substances absorbed by the roots pass into the cells of the leaves where they are concerned in the processes of constructive metabolism which are in operation in those organs.'

It is apparent that without this 'constructive metabolism' the materials of which the chief part of the plant is composed, mostly carbohydrates, could never be provided.

One of the functions of the absorption of water as such by plants is to secure the translation of these mineral elements from the soil to the parts of the organism where their constructive work is to be done.

Vines says: 'Only very dilute solutions of salts can be taken up by the roots; as a consequence, it is necessary that relatively large quantities of water should be absorbed in order that the plant may be supplied with the salts which are important in nutrition.'

The tree, during the whole period of its growth, does not use from without a single organic product. It gets its nitrogen in the form of nitric acid, its carbon in the form of carbon dioxid, its phosphorus in the form of phosphoric acid, its hydrogen in the form of water, and so on to the end of the nutrients. The fact that mineral matters are exuded in the leaves is no proof that they have not performed or assisted in performing the most important physiological functions. The excretion of a 'mineral constituent' may even be a proof of its importance in metabolism, as is the case with a great part of the phosphorus that is excreted from the body. Nature is careful to provide a superabundance of the most important substances. Because a tree may take up only one millionth part of the carbon dioxid which comes to it in the air during its period of growth, is no reason for saying that this constituent of the air is of little consequence in biodendry.

Mineral substances not only are useful and necessary in plant growth because of their part in forming tissues, but also because they stimulate by their presence the functional activity of the vegetative cells. In other words, they are condimental or katalytic as well as constitutional. Although potash is not a constituent of starch, it is thoroughly established by indubitable evidence that in the absence of potash in the plant blood starch granules are not formed.

The ions of mineral matter taken from the soil and coursing through the circulating apparatus of the tree perform useful and necessary functions from the time they enter the waiting mouth of the rootlet until they congregate in the extremest tip of the reddening leaf.

The 'mineral hunger' of plants is as well known and recognized by physiologists as that of animals, and the welfare of the growing tree is undoubtedly as profoundly affected by the soil element of its environment as by any other. Experiments have shown the minimum of any given mineral element of the soil which will permit normal development, but such a minimum only does so in case other mineral

elements are in excess. If the minima of all mineral elements are presented to the plant at the same time, normal growth can not take place.

In the experiments of Wolff it was conclusively shown that in such cases flowering and fruiting are practically prevented. The plant has, therefore, need of an excess of mineral matter, and this is secured from other mineral substances if one of the essential minerals is present in a minimum quantity. Thus some mineral foods may, temporarily at least, act as substitutes to a certain degree for others. Strange to say, however, sodium, which is so near potassium in its general properties, has but slight, if any, suitability as a substitute therefor. It is a mistake, therefore, to look upon the constitutional assimilation of mineral matters as their chief utility. The fact that both potash and phosphorus are always associated with the functions of the living cell is not to be forgotten. The absence of either of these minerals makes vegetable growth impossible. Especially are these two substances the katalytic agents whereby the living cell converts the other mineral foods of plants into starch, sugar, cellulose, oil and protein, of which the organic parts of plants are chiefly composed. These elements reach the tree solely through the soil, and the greater or less abundance of them in the soil can not fail to affect profoundly forest growth, perhaps to a greater extent than almost any other factor of the environment.

The soil has, therefore, marked ecological as well as physiological influences on forest growth. The soil of the forest is nature's own handiwork and will never be modified by man. When man begins his work the forest ends and the park begins. We all know how the soil alone has, in many instances, determined the character of tree growth. It is not wholly accidental that the sands are covered by pines and the mountains by oaks. The virgin forests in many localities were indexes whereby the early settlers selected their entries of land. They did not need to be told that the maple, the walnut and the tulip grew on the richer, and the beech, the gum and the oak on the poorer soils. The first forests that fell before the ax were those of the first-named trees. Thus the nature of the soil has often determined the original distribution of forest growth. Nature seems to know the edaphic principle in ecology better than man.

It is to be regretted that at this late day we should be told by such an eminent authority: 'Moreover, the total amount of mineral constituents in a tree is not only very small, but by far the largest portion is found in the leaves and young parts, suggesting again their merely fortuitous presence as a residue of the transpiration current, and mostly not required.'

I need hardly add the observation that the presence of mineral substances, both as such and as salts of the organic acids, profoundly modifies osmotic pressure, and without the aid of these substances the 'transpiration current' would never reach the tips of the trees, but, like the vanishing stream of the desert, be forever lost. The incidental fact of peripheral accumulation of mineral matter due to transpiration seems to have no bearing on the previous utility of the accumulated material during its passage through the cellular substance of the tree.

H. W. Wiley.

ARE STAMENS AND PISTILS SEXUAL ORGANS?

In Science, XVII., 652, Professor W. F. Ganong suggests that stamens and pistils are sexual organs, and gives some interesting reasons for this conclusion. In brief, he proposes to abandon the morphological point of view and adopt one purely physiological. It must be admitted that a genuine argument is presented here, but it is still open to question whether such a use of terms conduces to clearness. If the stamens are male organs, I suppose their product, the pollen spores, must be regarded as male cells. And if the pistil is a female organ, I suppose the scattering of pollen spores upon the stigma must, if one is consistent, be considered as a sexual act and, in that case, may be termed, as Mueller did, 'Befruchtung.' But to the mind of a morphologist this confusion of the processes of pollination and fecundation is extremely ob-

jectionable. The phylogenetic history and the ecological significance of the two processes are totally different.

Since the appearance of Goebel's 'Organography' it has been the fashion to urge the morphologists to be humble, but it is not impossible that a clear definition of terms in accord with the facts of phylogeny, such as morphologists have insisted upon, may still be of some value to botanical science.

When it is so easy to use such terms as 'staminate' and 'pistillate,' it seems a pity to permit flowers to be called 'male' and 'female.' CONWAY MACMILLAN.

PATAGONIAN GEOLOGY.

UNDER the title 'L'age des formations sedimentaires de Patagonie,'* Dr. F. Ameghino has issued a collection of papers relating to this subject published originally in the *Anales de la Sociedad Cientifica Argentina,* Vols. 50–54 (1900–1903). The chief purpose of this series is to refute the views on Patagonian geology expressed by Mr. J. B. Hatcher and myself.

Unfortunately, the representation of my statements as given by Ameghino is in almost every single case more or less inaccurate, sometimes my views are not properly understood, sometimes they appear distorted and even directly altered.

Since it is not worth while to correct all these misunderstandings—this correction being merely a reiteration of what I have said before—I do not think it necessary to go into detail. I only wish to caution any subsequent writer occupying himself with the question of Patagonian geology, not to rely implicitly on Ameghino's representations of my views and statements, but always to consult the original version of them, as laid down in the final report on the 'Tertiary Invertebrates of the Princeton Expedition.'†

A. E. ORTMANN.

PRINCETON UNIVERSITY.

* Buenos Aires, 1903.

† 'Reports of the Princeton University Expeditions to Patagonia,' vol. 4, part 2, 1902.

NOTES ON METEOROLOGY.

METEOROLOGICAL REPORTER TO THE GOVERNMENT OF INDIA.

SIR JOHN ELIOT, who has for a number of years occupied the important position of meteorological reporter to the government of India, and who received the distinction of knighthood on the occasion of the Durbar at Delhi, is to resign at the close of the present year. Mr. Gilbert T. Walker, who has been appointed Assistant Meteorological Reporter to the government of India, is to succeed Sir John Eliot on the latter's retirement. Mr. Walker is a fellow of Trinity College, Cambridge, where he attained highest honors in mathematics, and where he has taught mathematical physics since 1895. He has published a number of important researches on electricity and magnetism. After his appointment to the position of assistant meteorological reporter, Mr. Walker came to the United States, where he made a study of our methods of work in astronomy and in meteorology, visiting the Harvard and the Yerkes astronomical observatories, the Blue Hill Meteorological Observatory, the Weather Bureau in Washington, etc. Mr. Walker sails for India early in May. With his admirable training in mathematics and physics, his great ability to pursue original investigations along these lines, and his wonderful field for work in Indian meteorology, there is no doubt that Mr. Walker will make important contributions to our knowledge of the mechanics of the earth's atmosphere. He may be assured that he takes with him to his new field of labor the best wishes of American men of science for his success in a region where many of those whose names are written large in the history of meteorology have done their work.

DUNN'S 'THE WEATHER.'

'THE Weather' (New York, Dodd, Mead & Co. 1902. 8vo, pp. 356) is designed to 'avoid all mathematics, and scientific and technical terms (!), and present the subject in the simplest and most popular form.' The author is E. B. Dunn, for several years local forecast official of the Weather Bureau in New York City. The book endeavors to cover a large

amount of ground, with the result that most subjects are treated very superficially. There are also a great many inaccuracies. The chapters on weather maps and on weather forecasting are on the whole the best. In no way does 'The Weather' rank with the meteorologies of Hann, Davis, Angot, van Bebber, Mohn, Waldo and others.

NOTES.

THERE has recently been published a 'Catalog der in Norwegen bis Juni 1878 beobachteten Nordlichter, zusammengestellt von Sophus Tromholt' (Christiania, 1902. 4to, pp. 422). This catalogue was prepared for publication by J. Fr. Schroeter, of the University Observatory, Christiania, Tromholt having died on April 17, 1896.

THE volume on Meteorology of the 'International Catalogue of Scientific Literature,' published for the International Council of the Royal Society, is now on sale. It numbers about 200 pages, and costs 15 shillings.

R. DEC. WARD.

GENERAL JAMES T. STRATTON.

AFTER fifty years of professional activity in California, General James T. Stratton, the well-known surveyor, died at his home in Oakland on March 15. General Stratton was born in the state of New York in 1830, and came to California in 1850. After mining for a few years he resumed his professional work in 1853 and made the first official survey of the Alameda Encinal, at that time an uninhabited region. In 1858 he was elected county surveyor of Alameda County and was subsequently identified with the surveys of the large land grants made by the Spanish and Mexican authorities; through the knowledge acquired in this connection, he became a recognized expert on such land grants, their titles and boundary lines. He subdivided more of these, in many cases, immense areas, than any other surveyor in California. He also made the first survey for a railway out of Oakland by the way of Niles and the Livermore Pass to Stockton; these surveys extended to Folsom, Placerville being the objective point. This work was done for an English syndicate; the project was, however, abandoned because of the civil war. Later the rails were laid on these lines by Stanford and his associates, as the Western Pacific Railroad Company, later merged into the Central Pacific Railroad Company.

In 1873 he was appointed United States Surveyor General for California by President Grant, resigning in 1876 on account of ill health. From 1880 to 1883 he was connected with the State survey general's office, and from the latter date was engaged as a land attorney till 1899. To General Stratton belongs the credit of being the first to make an artificial forest west of the Rocky Mountains, he having in 1869 planted some forty-five acres with Eucalpytus trees of the species *E. globulus* and *E. viminalis*. He was a public-spirited citizen and quiet, unassuming gentleman.

ROB'T E. C. STEARNS.

LOS ANGELES,
April 24, 1903.

SCIENTIFIC NOTES AND NEWS.

MR. ANDREW CARNEGIE has offered to give $1,000,000 for a building for the engineering societies. It is to be situated in New York City, and will provide an auditorium, a library and headquarters for five engineering societies, namely, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Society of Electrical Engineers, the American Institute of Mining Engineers and the Engineers' Club.

FINAL contracts have been signed for the purchase from the Schermerhorn estate of the site in New York City for the Rockefeller Institute. The property acquired extends from Sixty-fourth street to a line 50 feet north of Sixty-seventh street from Avenue A to the East River. The price was about $700,000. The work of construction on the main building will begin about August 1.

BY vote of its council the Astronomical and Astrophysical Society of America will hold its next meeting in affiliation with the American Association for the Advancement of Science at St. Louis during convocation week, 1903–1904.

The Walker Grand Prize, which is bestowed once in five years by the Boston Society of Natural History, has just been awarded to J. A. Allen of the American Museum of Natural History 'for his able and long continued contributions to American ornithology and mammalogy.' The amount of the prize is $500, but in view of the high character of Mr. Allen's investigations, it was voted to increase the amount to one thousand dollars. Among the chief of Mr. Allen's investigations are his 'Birds of Florida,' 'A Monograph of the Pinnepeds,' 'Monographs of North American Rodentia' and 'The Geographical Distribution of North American Mammals.' The prize was last given (1898) to Samuel H. Scudder, of Cambridge, Mass., in recognition of his entomological work.

Dr. John H. Musser, of Philadelphia, has been elected president of the American Medical Association.

A branch of the American Institute of Electrical Engineers has been organized at Washington, with Dr. Frank A. Wolff, Jr., as chairman.

Sir Frederick Treves, the well-known English surgeon, has been given the LL.D. degree by the University of Aberdeen.

The Geographical Society of Paris has conferred the La Roquette gold medal on Captain Sverdrup, the Arctic explorer.

About fifty German students of agriculture are at present in the United States and will remain here about three months investigating agricultural methods.

Dr. Edmund Otis Hovey returned on May 8 from a three months' trip to the Caribbean Islands. He was sent out by the American Museum of Natural History to continue and extend the observations on the West Indian volcanoes which he began directly after the great eruptions of a year ago. During the present trip, Dr. Hovey visited all the volcanoes from Saba to St. Vincent, devoting most of his time to Martinique and St. Vincent. Many fine specimens and photographs were obtained for the museum.

Professor Henry S. Graves, director of the Yale School of Forestry, has gone abroad, and will spend the summer on the continent studying schools and methods of forestry.

Dr. F. S. Earle, assistant curator at the New York Botanical Garden, sailed for Porto Rico on May 9 to make an investigation of the diseases which affect the vegetable products of the island.

Professor J. C. Merriam, of the department of geology, University of California, will go to the southeastern part of Idaho this summer to search for reptilian remains in a portion of the Triassic formation lower than those in which such remains have been found.

Professor A. A. Veblen, of the department of physics at the State University of Iowa, will spend his summer vacation in making a visit to Norway. While absent he will study the history and development of ancient ship building as evidenced by the remains of old vessels preserved in the museums of that country.

The board of regents of the University of Michigan at their April meeting granted leave of absence for the year 1903–04 to Dr. Herbert S. Jennings, assistant professor of zoology. Dr. Jennings will spend the year at the Zoological Station at Naples, Italy, in prosecuting investigations on the behavior of the lower organisms, continuing researches on which he has been engaged for some years. For the furtherance of this work the Carnegie Institution has made a grant of $1,000, in addition to the sum of $250 granted last fall, together with the use for the year of one of the tables maintained by the institution at the Naples Zoological Station. Dr. Jennings expects to leave for Italy at the close of the summer session in August.

The large number of fossil fishes collected during the excavations at Boonton and elsewhere in the Triassic area of New Jersey during the last year or two are being studied by Dr. Charles R. Eastman, of the Museum of Comparative Zoology, Cambridge, Mass.

The first link, Vancouver to Fanning Island, of the transpacific longitude, of which Mr.

Otto Klotz has charge, has been successfully established.

A REUTER telegram from Cape Town states that Dr. Rubin has left for Chinde, with an expedition numbering 280 persons, for the purpose of measuring an arc of meridian into northeastern Rhodesia, from the Zambesi to Lake Tanganyika. The expedition will be away three years, and is expected to yield important data in connection with the determination of the earth's dimensions.

IT is reported from Berlin that Mr. Walker, who is scheduled as the successor of John Eliot as superintendent of the German Indian Meteorological Service, recently spent a week at the aeronautical observatory with a view to establishing experimental stations in India for the observation of monsoon conditions by means of kites and kite balloons. The first station will be in the Himalayas at Simla, seven thousand feet above the level of the sea.

A PORTRAIT of Dr. James H. Richardson, for many years professor of anatomy in the Medical Department of Toronto University, has been presented to the university by his former students.

AT the British National Physical Laboratory, Mr. C. C. Paterson has been appointed to take charge of the electro-technical and photometric work, and Mr. F. J. Selby has been appointed to prepare certain tide tables for Indian ports and to act as librarian.

THE centennial of the birth of Justus Liebig was celebrated on May 12 at the Chemists' Club, New York City. Dr. Ira Remsen, president of the Johns Hopkins University, and Professor William H. Brewer, of Yale University, were expected to make the principal addresses.

MR. ARTHUR E. SWEETLAND, the youngest member of the staff of the Blue Hill Meteorological Observatory, died on May 8. Mr. Sweetland had been connected with the Observatory since 1896, and several of his investigations, notably a study of cloud forms which had long occupied his attention, were published in the *Annals* of the Harvard College Observatory. He also aided the director, Mr. Rotch, to obtain the first meteorological records high above the Atlantic Ocean, as was described in SCIENCE in 1901.

THE daily papers state that Dr. R. N. Hartman, professor of analytical chemistry at the School of Mines at Golden, Colo., was killed by escaping gas in his laboratory on May 8.

WE regret also to record the death of Professor Carl Anton Bjerknes, professor of pure mathematics at the University of Christiania, at the age of seventy-eight years, and of Dr. G. C. Dibbits, formerly professor of chemistry at Utrecht, at the age of sixty-four years.

UNIVERSITY AND EDUCATIONAL NEWS.

THE enlargement of the Silliman Laboratory of the Mount Hermon School is rapidly approaching completion. This enlargement was made possible through a gift of $13,000 from Hon. H. B. Silliman, who erected and equipped the original building in 1892. The laboratory when completed in June will represent the expenditure of nearly $40,000 by Dr. Silliman for scientific purposes. Professor C. E. Dickerson, who is in charge of the laboratory, has directed the work of enlargement.

THE late Walter D. Pitkins has bequeathed $10,000 to Yale University, one half to be used for a scholarship and one half for a prize in mathematics.

THE Harvard Club of Chicago has given $5,000 to found a scholarship in memory of Dunlop Smith.

MR. FRANCIS L. STETSON, of New York, has given $25,000 to Williams College. Mr. Robert C. Billings has given the same sum to Wellesley College.

DR. GEORGE M. TUTTLE, professor of gynecology; Dr. George L. Peabody, professor of materia medica and therapeutics, and Dr. Robert F. Weir, professor of surgery, have resigned their chairs in the College of Physicians and Surgeons, Columbia University. Dr. Weir was appointed professor of clinical surgery, and Drs. J. A. Blake and G. E. Brewer were made lecturers in surgery. Dr. Christian A. Herter was elected professor of pharmacology and therapeutics. Dr. Edward B. Cragin succeeds Dr. Tuttle in the department of gynecology.

Among the promotions and new appointments at Columbia University are Dr. C. C. Trowbridge and Dr. F. L. Tufts to be instructors in Physics; Dr. B. Davis, tutor in physics; Dr. A. P. Wells, instructor in mechanics; Dr. R. S. Woodworth, instructor in psychology, and Dr. W. P. Montague, lecturer in philosophy.

Dr. G. H. Howe, now assistant professor of physics at Dartmouth, has been elected to the Appleton professorship of physics, in succession to Professor E. F. Nichols, who has been called to Columbia University.

At a recent meeting of the board of trustees of the New Mexico School of Mines six additional chairs in the faculty were established. These were mining, physics and electrical engineering, mechanical engineering, mineralogy and petrography, metallurgy and languages. Several special lectureships were also provided. Carl E. Magnusson, B.E.E., Ph.D., from Wisconsin University, has been appointed to the chair of physics and electrical engineering; Charles T. Lincoln, B.S., of the Massachusetts Institute of Technology, has been appointed acting professor of chemistry, and Francis C. Lincoln, B.S., M.E., late of the San Barnardo Mining and Milling Co., has been placed in charge of the metallurgical department. President Keyes announces that hereafter regular summer work will be carried on at the institution. This work will continue through seventeen weeks and will count as a half year's credit. Field work in geology, surveying and mine examinations, and special investigation will occupy the time of certain classes. Practical metallurgy in its various phases will also be carried on.

The University of Montana will be well represented this summer both in field and class work. The University Summer School will open June 15, and continue for six weeks. Eleven departments will offer work, and the new Woman's Hall will be completed and opened for this session. The Biological Station work, at Flathead Lake, under the directorship of Professor M. J. Elrod, with a corps of instructors, will give several field and laboratory courses both in botany and zoology. The station will open the middle of July and continue for five weeks. The department of geology will conduct an expedition in the southeastern part of the state. This expedition will be composed of several students and an official photographer, and be in charge of Professor J. P. Rowe. The party will leave the university about the middle of June and remain in the field from six to eight weeks.

Director R. H. Thurston, of Sibley College, Cornell University, has accepted an invitation from the trustees and faculty of the Iowa State College at Ames, Iowa, to deliver the address at the dedication of the new engineering hall on May 21. The new building was built at a cost of $220,000.

The Rev. Charles S. Murkland, who for the past ten years has been president of the Agricultural College, Durham, N. H., has been forced to resign. According to the *Manchester Union*, the governor of the state, Mr. Bachelder, may be made president. This newspaper indicates that there are political intrigues in connection with the presidency.

A school of applied science has been created by the board of regents of the University of Iowa, and Professor L. G. Weld has been appointed director.

Mr. William Kent, of New York City, has been elected dean of the L. C. Smith College of Applied Science of Syracuse University.

Professor Robert Sample Miller, associate professor of mechanical engineering at Purdue University, has been elected to a similar position in the newly organized department of engineering at Colorado College. At this institution Dr. Florian Cajori, professor of mathematics, has been elected dean of the school of engineering.

Dr. Norman M. Harris, associate professor of bacteriology at the Johns Hopkins Medical School, has accepted a call to the University of Chicago.

Mr. C. A. Ashford, who has had charge of the teaching of science at Harrow since 1894, has been appointed headmaster at the Royal Naval College, Osborne.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 22, 1903.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE DUTIES AND RESPONSIBILITIES OF TRUSTEES OF PUBLIC MEDICAL INSTITUTIONS.**

THE value of occasional and stated gatherings of the principal leaders of medical thought in the various special departments is acknowledged by all. Certainly those who have attended this congress, now held for the sixth time, have felt its broadening influence. We are all apt to become narrow when we are devoted heart and soul to one specialty, be it medicine, surgery, physiology, ophthalmology or any other. When we meet nearly all the more prominent men in cognate interrelated branches of medicine in Washington every third year, we are sure to find that there are as interesting and as important questions in other specialties as there are in our own; and, moreover, we are sure to find that there are men of as acute intelligence, wide reading and original thought in other than

* The presidential address at the sixth congress of American Physicians and Surgeons, Washington, May 12, 1903.

our own departments whom it is our pleasure to meet, and whose acquaintance becomes not only valuable for what we find them to be, but because of the stimulus that they give to our own thoughts.

Ordinarily the presidential address has been devoted to some special professional topic. My first idea was to select such a subject for to-night, but as I was absent from the country when I received the very highly appreciated notice of my selection, I asked the members of the executive committee for suggestions, being sure that their united judgment would be better than my own. I was very glad when they proposed the topic upon which I shall address you, partly because it is different from the usual type of such addresses, and partly because it seems to me appropriate to the present time. I shall, therefore, give the time at my disposal to presenting to you some thoughts on 'The Duties and Responsibilities of Trustees of Public Medical Institutions.'

Before entering upon my topic I beg to state explicitly that what I may say is offered in no spirit of unfriendly criticism, but only by way of friendly suggestion. I have been too long and too intimately associated with scores of such trustees not to know that they are almost without exception generous, self-sacrificing, giving of their time and money and thoughtful care without stint and often sacrificing personal convenience and comfort for the good of the college or hospital which they so faithfully serve. Anxious to discharge their trust to the best of their ability, I am sure they will accept these suggestions, the fruit of forty years of personal service as a teacher and a hospital surgeon, in the same friendly spirit in which they are offered.

There are two such classes of institutions to be considered: (1) Medical colleges, and (2) hospitals, whether they be connected with medical schools or not.

There is, it is true, a third class of trustees for a wholly new kind of medical institution which has arisen as a modern Minerva Medica, born full-armed for the fray. Of this class we have as yet but a single example—the Rockefeller Institute for Medical Research. Akin to it are laboratories for special investigations, such as the two cancer laboratories in Buffalo and Boston. But the Rockefeller Institute is so recent, and its scope at present necessarily so undetermined, that I would not venture to consider the duties of these trustees, and I am sure their responsibilities are adequately felt by them. Moreover, their admirable selection of a director for the institution is the best pledge of a future wise administration. I heartily congratulate the profession and America upon the establishment of so peculiarly useful an institute. Its founder has wisely left its work unhampered saving as to its general purpose, and the whole world, and especially the United States, will soon be his debtor for researches and discoveries that will abridge or even abolish some diseases, shorten sickness, prolong life and add enormously to the sum of human happiness. Could any man of wealth by any possible gift win for himself a higher reward or a happier recollection when he faces the future world?

Though not a medical institution, I can not refrain also at this point from expressing not only for myself, but for you, our hearty appreciation of what the Carnegie Institution has done for medicine in the reestablishment of the 'Index Medicus.' This publication is essentially and peculiarly American in origin, but its usefulness is worldwide. It aids alike an author in Japan or in India, in Europe or America. It is one of the best and wisest under-

takings of this lusty educational giant. But to ensure the permanent publication of the 'Index Medicus' the profession must show that it really values this generous gift. Unless the 'Index' finds a hearty support in the profession abroad and especially at home, we can hardly expect the continued publication of this unique and invaluable publication. May I earnestly ask, therefore, of this audience of the chief medical authors of the United States that each one will demonstrate his appreciation by an immediate subscription to the 'Index Medicus.'

There are some matters common both to the medical college and the hospital which may be considered together. The most important of all these is the cordial and hearty cooperation of the medical men connected with the college or hospital and the boards of trustees. In order to ensure this the members of each body must be acquainted with each other. I have known of instances in which if a professor in the medical school ventured to suggest any changes as to its management, or even to state his opinion as to the qualifications of a candidate for a vacant professorship, his suggestions were resented as an interference instead of being welcomed as a means of valuable information. I take it for granted that we should not offer such suggestions after the fashion of a partisan either of a man or a measure, for the advancement of a friend or to the disadvantage of an enemy, but solely for the good of the institution with which we are connected. He who would endeavor to foist a friend upon an institution *because* he is a friend, and in spite of the fact that a rival is the abler man and better fitted for the position, is just as false to his duty to his college or to his hospital, as the trustee who would vote for the less desirable man on the ground of personal friendship or of association in some society, church or other similar body. Of all these influences, that arising from membership in the same religious body is, I fear, the most frequent and yet most absolutely indefensible. What one's theological opinions are has no more to do with his qualification for a professional or hospital appointment than his opinions on protection as against free trade, or whether Bacon or Shakespeare wrote Hamlet.

I have always honored one of a board of trustees, who was an old personal friend of my father's and who had known me from boyhood, yet who in my early professional career, when I asked for his vote for an important hospital appointment, had the manly courage to tell me that he thought a rival, who was older and more experienced, was the better man for the place and that he should, accordingly, vote for him and not for me. I confess it was at the time a bitter disappointment to me, but I never had so high an opinion of my father's friend as after he denied me his vote.

There should be, in my opinion, but two questions asked in considering the election of either a professor or a hospital physician or surgeon. First, which one of the candidates for the place has the best qualifications from the medical point of view? This should include not only his scientific knowledge, but his ability practically to impart or to apply that knowledge. Secondly, are his personal qualifications and character such as to make him a desirable incumbent of the position? It must be remembered that a man may be scientifically and practically an extremely able man, but of such a quarrelsome disposition, or the unfortunate possessor of some other similar personal disqualification, as to make him a most undesirable member of a staff. The personal equation may be

quite as important as the scientific qualification. Of course his personal moral character should be above reproach. To place a drunkard or a libertine in a position of so much responsibility and influence is to abuse a trust. No patient should be confided to the care of such a man and still more no such man should be made an instructor of young men, upon whom his influence would be most disastrous.

It is often extremely difficult for a layman to reach a correct conclusion as to the qualifications of medical men for college or hospital appointments, because of the confident, yet conflicting, statements of their friends. But there is apt to be a certain clear partisanship in such statements which betrays the purpose of the speaker. Especially will this be so if he advocates the election of A or B on the lower grounds of friendship, social position, or for other similar motives. The man who is advocating the best man because he *is* the best man has the stamp of sincerity upon every word.

Perhaps the most striking example I can advance of such an unfortunate misjudgment is Dr. S. Weir Mitchell, who was denied a professorship in both the medical institutions of his native city, thus depriving them of the most brilliant medical genius that America has produced within my personal recollection. For him it is now a matter of indifference, and for American literature it has been a gain. But for medicine, and especially for physiology, it was an immense loss. Both of his rivals were estimable, worthy gentlemen who held an honorable position in the profession, it is true, but Mitchell is a genius. 'Eclipse was first; the rest were nowhere.'

One of the best methods of bringing the medical board and the board of trustees into more intimate contact would be to have the dean or a committee of the faculty, or, in a hospital, if the staff is not too large, the whole staff invited to the meetings of the board. Here I can speak from personal experience. At the Orthopedic Hospital and Infirmary for Nervous Diseases in Philadelphia, there are three surgeons and three physicians. These members of the medical staff are invited to meet with the board of managers at each monthly meeting, excepting the annual meeting, when the medical staff is elected. They are free to express their opinions on any topic relating to the management of the hospital to which their judgment may contribute something of value, but when a decision is taken they have no vote. It is purely in an advisory capacity and for the purpose of giving and receiving information that they are present. The plan works exceedingly well. When economy is necessary in the hospital, the staff is fully acquainted with the fact and can cooperate with the trustees; when expenses have run up from carelessness in the wasteful use of dressings or appliances, a halt is called; when, alas, very rarely, the treasurer is all smiles, and plans for the extension of the hospital, or the installation of some new addition to the plant is contemplated, their knowledge as to the necessity, for instance, of a hydrotherapeutic or an x-ray plant, or a new operating room, is of the greatest possible value. Nothing but good, in my opinion, can come from such personal cooperation.

One of the difficult questions which boards of trustees have to face is whether there shall be a fixed age at which a college professor or a hospital physician or surgeon shall retire from the active duties of his post. I firmly believe that they should fix such a retiring age in the interest of the students and the patients. As age advances, a man's opinions and his

practise become 'as petrified as his arteries.' He is incapable of constant study, of adding to his knowledge or of keeping up with the feverish strides of medicine. He ought then to be relieved of his cares and his duties. If no rule exists, he is allowed to continue his inefficient or even disastrous work, or by some harsh suggestion is compelled to give place to another more competent man. A rule is a condition accepted when he is appointed, and just as in the army and navy, when an officer reaches 64 or 62 years of age he is retired on reduced pay, and because it is a rule he does not feel hurt or humiliated; so in a college or a hospital, when time and the rule brings us to the period when we must gracefully retire, no one's reputation is injured or his feelings lacerated.

I have ascertained that the following rules are now in force in some of the larger institutions:

At Harvard, the age when a professor may request to be retired is 60, provided he has been in the service of the university for 20 years, with a reduced pay ranging from one third to two thirds of his salary. At 66 he may be retired by the president and fellows partly or wholly. The details of the plan are admirably arranged.

At Chicago, while no plan is yet in force, largely, I presume, because of its recent establishment on the present basis, such a plan will soon be made operative.

At Columbia the retiring age, after 15 years of service, is 65, either at the request of the professor or upon motion of the trustees, and on half pay.

At Yale the retiring age is 65, after 25 years of service, and on half pay, but the retirement is not compulsory. It will probably be made compulsory before long.

At Cornell the retiring age is 70, but the pension fund will not be available until 1914. The retiring pension will then be $1,500.

At the University of Pennsylvania and at Johns Hopkins no retiring age is fixed.

The only hospitals I know of in which a retiring age is fixed are the Massachusetts General Hospital and the Boston City Hospital. At the former the compulsory retiring age of the surgeons is 63, and of the physicians 65. At the Boston City Hospital the visiting surgeons are retired at 65, but the physicians, gynecologists and all the other medical officers continue in service indefinitely—a very curious anomaly.

These varying but in the main identical provisions, when any exist, show the trend of thought and practise. They generally apply to the medical department, except that in case a professor is engaged in the practise of his profession and so has a private income, the provision for continuing a portion of his salary does not apply. This is right and fair. Of course, in all hospitals where there are no salaries, no provision as to reduced salary would obtain.

The point I wish to emphasize is, however, that the age limit (which in my opinion should be 65) should be *compulsory* and so not be invidious in any given case. It will be objected that not a few men are in full intellectual and physical vigor at 65, and it will be a detriment to the institution to lose their services when their ripe experience and admirable teaching are most desirable. I admit it. But for every one such case of harm done by compelling a man to stop, there are a score of instances of men who are doing vast injury by their inefficiency. Moreover, in the very few cases in which it might be allowable, as boards of trustees make rules they can unmake them, and in special cases they could pay a graceful compliment and

preserve to the institution their exceptional men by extending the limit to 70. In no case can I think it wise to go beyond this limit.

In some of the universities I have quoted a sabbatical year of rest or study is allowed a professor. He is put upon half pay and his place is filled by a temporary substitute, who receives the other half of his salary. I believe that in present conditions this should not be applied to medical faculties, for nearly all of the professors are in active practise and take sufficiently long summer holidays. These latter are often spent in observation and study abroad—a most useful and remunerative employment of a holiday—and serve the purpose of the sabbatical year for men whose entire time is given to their teaching. In hospitals it certainly should not apply.

One of the recurring questions in hospital and college management is whether there should be a certain number of doctors on the board. I know that there is a wide diversity of opinion upon this point. My own belief is that a small proportion of well-chosen medical men is a distinct advantage in such boards of trustees. I have said a 'small proportion,' for it should not be, I think, larger than probably 20 per cent.; and I also said 'well-chosen'; that is, they should be men of large mental caliber and executive ability. It should be distinctly understood, if not indeed absolutely expressed, in institutions in large cities at least, that any physician or surgeon placed upon such a board should never be eligible, even by resignation from the board, for a position on the faculty or the medical staff. In small towns the lack of suitable persons for hospital trustees and members of the hospital staff might make it desirable not to institute such a rule.

Moreover, such medical men should be selected for trustees as by their mental training, social relations and personal character would be, so far as it is possible for human nature to realize such a position, absolutely free from influences arising from personal jealousy or professional bias. If it were a social club, it would be perfectly proper to vote against a man because he is personally distasteful, but where it is a scientific body responsible for the education of large numbers of young men and for the care of still larger numbers of hospital patients among the poor, even if a candidate were personally unfriendly I should vote for his election if he were the man best fitted for the place.

Turning now to the duties and responsibilities peculiar to trustees of hospitals, let me point out the objects of a hospital.

First, the care and the cure of the sick and injured; secondly, the education of medical men and medical students; and thirdly, the promotion of knowledge, which, in turn, will inure all over the world to the more speedy and certain cure of the sick and injured, and so be of the greatest benefit to humanity.

In order to accomplish these three purposes, it is necessary that the hospital shall have sufficient funds to purchase ground, erect buildings and provide a thorough material equipment. It is a great pleasure to me, as to you also, to note that throughout the length and breadth of the land the medical and surgical staff never tax the always inadequate resources of hospitals for any remuneration. They serve without pay, they give ungrudgingly and freely day and night to the poor, often for many years, their time and skill without ever a thought of any money reward. Their reward comes from increased knowledge and skill, and the daily blessing invoked of heaven, often lisped in children's prayers or breathed in mothers' benisons which

pass not unheeded by the recording angel.

But, as I have pointed out elsewhere, instead of receiving any pay, they give to hospitals. The mere money value of this daily gift of the profession to the poor amounts to an enormous sum. The value of the professional services of the staff of the Jefferson Medical College Hospital, a single hospital in a single city, on a moderate basis of fees, I found was more than half a million dollars annually. The millions upon millions of money given in that most self-sacrificing form—personal service—by the entire profession all over the United States, and I might add with still further pride, all over the world, is simply incalculable. The Gideon Grays and Weellum MacLures are not found only in Scotland or at the countryside. They are even more plentiful in the slums of our great cities, giving of their time, their skill, and what is more, their hearts, their lives, themselves to the service of humanity.

Trustees sometimes seem to take it for granted that their duties are ended when they have done two things: begged or given and safely invested the necessary funds, and then elected the staff. To my mind, their duties do not by any means end at this point. They should see to it that the resources of the hospital are utilized to the utmost in doing the largest good.

Let us see now how the objects of a hospital, as I have stated them, can be realized. The first object is the care and cure of the patients. But the cure of any individual patient is not the 'be all and the end all' of a hospital. His cure must be a means of larger vision to the doctor, who will thus be better fitted to care for future similar cases. Even his death, if he can not be cured, should minister to the increasing knowledge and skill of the doctor, so that he may be able to snatch future victory from the present defeat.

The second—the training of doctors and students—is frequently carried out, but sometimes even objected to. There are three classes of doctors who are trained by a hospital: first, the staff of the hospital itself. I have lived through the period of the establishment of hospitals in many of the smaller cities and towns, and in some cases even villages in this country, for it was a rare thing in my early professional life for any except the larger cities to have hospitals. The moment that a hospital is established with its medical and surgical staff, that moment a new era has dawned on the community in which the hospital is established. More careful methods are introduced, greater cleanliness is observed, hygienic conditions are bettered, laboratory methods are inevitably introduced in time. Even if the old-timers who graduated years before our modern laboratory methods were adopted do not care for them or can not use them, the young fellows who come fresh from our medical schools and serve as residents, and even the nurses graduated from our training schools, finally shame the older ones into better ways and greater exactness, not only in the hospital, but in their private work as well.

As a consequence of the establishment of these hospitals and the added skill and training of the local physicians and surgeons, the character of the consultations of the physicians and surgeons of our great medical centers has been greatly modified. The really simple cases, such as hydrocele and small tumors (and even large ones), clubfoot, harelip, etc., which used to be sent to city consultants, are now successfully operated on by the local surgeons, and only the more difficult, serious or complicated cases are sent to the cities. This is a great advantage to the patient, whose good is the first consideration, and to the local medical

men; and though seemingly a serious loss to the city consultant, it is in the end an advantage, as he must prove his better metal in the higher scientific fields and be, as well as seem to be, the better man.

Moreover, the trustees of every hospital should see to it that a good library and laboratory are provided. Insensibly the staff will read more and more. A single restless, progressive spirit, even though it be a young interne, calling attention to this case and to that, in one journal or another, will compel the rest of the staff to read in spite of themselves. It is absolutely clear that a laboratory with modern equipment for bacteriological, pathological and chemical research in its examination of tumors, of the urine, the sputum, the feces, the blood, the pus, and other fluids from wounds, etc., is a necessity in every hospital. Even many of our smaller hospitals are equipped with microscope and reagents if not with a complete bacteriological outfit, which nowadays is inexpensive and imperative. All of this raises the intellectual and professional standard of the staff. I venture to say that no town of 20,000 people can afford to be without its hospital for the sake of its *own citizens,* utterly irrespective of the good it does to the poor who are treated in its wards. It must be established in the interest of the *well-to-do citizens* and their families, so that they may secure better equipped doctors for themselves as well as for the patients in their hospital. Self-interest, therefore, will compel every community to establish its hospital, even if charitable motives had no influence.

Again, the trustees of all hospitals of any size should establish a training school for nurses. Only those who, like myself, have lived in the period before such training schools were established, can appreciate the vast improvement effected in a hospital by this change. To replace the former ignorant, untrained attendants by 'trained nurses whose jaunty caps and pretty uniforms and often winsome faces almost make one half wish to be sick, and when one is sick, half loath to be well,' is not only a boon to the patients but to the doctors as well. The intelligent, well-trained nurse, who is on the alert to observe every important change of symptoms and who will keep accurate bedside notes, is the doctor's right hand. Not a few patients who would otherwise lose heart and hope are, one may say, lured back to health and happiness by the tactful attentions and restful but efficient care of such a nurse. The community of the well-to-do also are benefited, because the hospital provides them with skilled nurses in their homes when they are so unfortunate as to be compelled to remain there instead of going to the hospital.

The old repugnance to entering a hospital when sick or when an operation is demanded is rapidly fading away. The immense advantages of a good hospital over the most luxurious home are now acknowledged on all hands. The poorest patient in a hospital is better cared for, his case more carefully investigated by bacteriological, chemical and clinical methods in a hospital, than are the well-to-do in their own homes. Indeed, wise surgeons, except in cases of emergency, now very properly refuse to do operations in homes instead of in hospitals. In many instances lives that would be lost in homes are saved in hospitals, where the many and complex modern appliances for every surgical emergency are provided.

The hospitals in direct or indirect connection with medical schools, however, do a far larger work than merely the training of their own staffs of doctors. They train three other classes of doctors: First,

the undergraduates who are aspiring to the degree; secondly, graduate physicians who spend a certain amount of time in the hospitals either as internes or as temporary students refurbishing their professional knowledge; and thirdly, experts in certain branches of medicine and surgery.

The undergraduates are taught first in the general clinics, where to some extent they learn both by didactic instruction and by seeing the patients, hearing their histories and witnessing the institution of proper treatment by prescription, by regimen, or if necessary, by surgical operation. This is of great value, particularly in the more important cases, and especially, for I speak now as a surgeon, in important operations. It is often objected that students see nothing in large clinics. To some extent this holds good; but no student can look on at an operation when the jugular vein or the lateral sinus is torn, the pleural cavity opened, the bowel lacerated, or other of the great emergencies of surgery occur, and fail to be impressed by the coolness of the operator, the carefully explained methods adopted for remedying the mischief, and the various devices used to save life, all of which hereafter will be used by him when similar emergencies may occur.

Yet far more important than the public clinics are the smaller clinics held with classes of ten to twenty men each, when under an experienced teacher the absolute work of the clinic is divided among the various students in turn, watching the pulse and the respiration, giving an anesthetic, assisting actively at operations, percussing the chest, palpating the abdomen, determining inequalities of the surface or the varying density of underlying organs. Here is the real forum in which our modern medical student acquires his skill. In many cases visits in the ward itself are made, and to a small group around the bedside the physician or surgeon will point out the phenomena to be recorded, the need for the examination of the blood, the results of bacteriological cultures, the facts discovered by the microscope, or the chemical reagent. By the Socratic method also, he will reveal to the student the imperfection of his knowledge, call out—e-ducate—his powers of observation, of reasoning; stimulate his thought, and give him an impetus which will last throughout life. Who that has 'walked the hospitals' with a Skoda, a Trousseau, a Nélaton, a DaCosta or a Mitchell can ever forget their teaching?

It is sometimes objected by those who are not familiar with the actual facts, and especially by trustees, that this method of actual bedside instruction does harm to the sick. I speak after an experience of nearly forty years as a surgeon to a half dozen hospitals and can confidently say that I have never known a *single patient* injured or his chances of recovery lessened by such teaching. Of course, the physician or surgeon uses common sense. He would not allow a number of men to palpate the abdomen of a patient with peritonitis, or move an acutely inflamed joint, nor would the physician allow a patient with pneumonia to have the chest unduly exposed, or a typhoid fever patient disturbed if his condition were such that it would be inadvisable. But such cases are the exception. In fact, many of you are familiar with patients who have responded to repeated percussion by members of such a class by prompt recovery, attributed by the patient to the supposed medication of percussion. Moreover, it is by this actual practice only that the student acquires the necessary skill in the use of modern instruments of precision, such as the stethoscope, the laryngoscope, the esthesiometer, the

sphygmomanometer, the various specula. Here he learns when to make blood counts, how to take histories, arrives at the actual facts by skilful cross-questioning, notes the varying symptoms and physical signs of a case, determines the need for laboratory investigations, all under the guidance of skilled observers, who will point out his errors, encourage his queries and stimulate his thought.

Moreover, trustees may overlook one important advantage of a teaching hospital. Who will be least slovenly and careless in his duties, he who prescribes in the solitude of the sick chamber, and operates with two or three assistants only, or he whose every movement is eagerly watched by hundreds of eyes, alert to detect every false step, the omission of an important clinical laboratory investigation, the neglect of the careful examination of the back as well as of the front of the chest, the failure to detect any important physical sign or symptom? Who will be most certain to keep up with the progress of medical science, he who works alone with no one to discover his ignorance; or he who is surrounded by a lot of bright young fellows who have read the last *Lancet,* or the newest *Annals of Surgery,* and can trip him up if he is not abreast of the times? I always feel at the Jefferson Hospital as if I were on the run with a pack of lively dogs at my heels. I can not afford to have the youngsters familiar with operations, means of investigation or newer methods of treatment of which I am ignorant. I must perforce study, read, catalogue and remember; or give place to others who will. Students are the best whip and spur I know.

Of the value of training graduates in postgraduate work I need scarcely speak, to this audience at least. The doctor who graduated five, ten or fifteen years ago comes to our great centers of medical education and renews his youth at the fountain of knowledge. He learns the use of all the new instruments, sees new methods of operation, new methods of treatment, new means of diagnosis, and goes home an enormously better equipped man.

The trustees should see that the staff does not become fossilized by following the same ancient local methods from year to year, but should encourage them to visit other hospitals, see other men operate, hear other men discourse on the latest methods of investigation, and then import into their own hospitals all the good found elsewhere. I learn a deal by such frequent visits to the clinics of my brother surgeons, and if one who has grown gray in the service can thus learn, surely the younger men can do so. When we are too old to learn we are too old to remain on a hospital staff.

I do not know anything which has more impressed upon me the enormously rapid progress which surgery is making than a recent experience. I was absent from this country for almost a year and a half. In that time circumstances were such that I saw almost no medical journals and but few doctors. I have been home now eight months and even with incessant work I have not yet caught up, so rapid has been the progress of surgery in this short time. Had I been absent for five years, verily I should have been a 'back number,' and never could have caught up at all.

In his very excellent presidential address before the Association of American Physicians in 1901, Professor Welch made a plea for hospitals to afford 'the requisite opportunities to young men who aim at the higher careers in clinical medicine and surgery.' He called attention to the fact that in our bacteriological, pathological and anatomical laboratories the opportunities, though still too few, were reasonably good, and in a

few places exceptionally good, for the training of young men for positions as teachers of anatomy, pathology and bacteriology. Any young man in these departments who by good hard work makes for himself a name is fairly sure, before long, of being called to some important post as a professor, director of a laboratory, or some similar position. But the opportunities for work in clinical medicine and clinical surgery are far more restricted, since opportunities for both the exercise of their clinical skill are less frequently open to them and the opportunities of combined physiological, pathological, bacteriological and anatomical research along with their clinical work is but scantily provided for. This plea is reinforced by the recent paper of Sir Michael Foster (*Nineteenth Century*, January, 1901, p. 57). These special graduates, bright young men, determined to devote themselves to one or another department of medicine or surgery, are the men who bring honor to the school at which they obtain their training, and are invaluable to the community. They are the future Jenners, Pasteurs, Virchows, Listers, DaCostas and Grosses, and our hospitals should provide for these exceptional men exceptional facilities.

The third object of a hospital is the promotion of knowledge, and so, fourthly, the good of humanity. Physicians and surgeons engaged only in private practice do not generally keep notes of their cases, and rarely publish important contributions to knowledge. I find in 100 books taken consecutively in my library that 85 were written by hospital men and only 15 by authors not connected with any hospital so far as was indicated on the title page.

In order that proper investigations may go on, trustees should enforce a permanent record of all the cases treated in the hospital, properly indexed, from which the staff may derive their data for papers and books. Each large hospital should have its pathological resident as well as the clinical residents in the various wards, so that post-mortem records shall be well kept, pathological, bacteriological and chemical investigations of various secretions, or blood counts, etc., shall be properly made and permanently recorded in such a manner as to be accessible.

It is too often the case that trustees, as I have said, regard their duties and responsibilities at an end when they have taken care of the funds and elected the staff. They may say that after all this is their real duty, and that all that I have advocated is medical and surgical, and the responsibility for it should devolve on the staff and not on the trustees. I do not take so narrow a view of the duties of trustees. When they have elected a physician or surgeon, if he neglects his duty, it is their business to displace him and fill his place with another man who will attend to his duty, and the duties that I have indicated pertaining to the increase of knowledge as well as of its diffusion are quite as much within their province as it is to see that the funds are invested to the best advantage. The intellectual funds as well as the invested funds must bring in good dividends.

If trustees and staff work together for such a purpose and in such a manner, they will create an ideal hospital which will do more good to the patients than any other type of hospital. It will attract the best physicians and surgeons in every community, will acquire the best reputation, not only local, but it well may be national, and do the most for the good of science and the benefit of humanity.

It may be said that this is an unduly strenuous view of the duties of trustees,

that in our father's day and in our own earlier lives no such conditions existed or were contemplated. "I need hardly ask a body like this," said President Roosevelt in addressing the Methodists assembled in council, "to remember that the greatness of the fathers becomes to the children a shameful thing if they use it only as an excuse for inaction instead of as a spur to effort for noble aims. * * * The instruments with which and the surroundings in which we work have changed immeasurably from what they were in the days when the rough backwoods preachers ministered to the moral and spiritual needs of their rough backwoods congregations. But if we are to succeed, the spirit in which we do our work must be the same as the spirit in which they did theirs."

Moreover, we must remember that "the world-field into which all nations are coming in free competition by the historical movement to which all narrower policies must sooner or later yield, will be commanded by those races which, in addition to native energy and sagacity, bring the resources of scientific investigation and of thorough education." The international race for the leadership of the world is just as strenuous and intense in medicine as it is in commerce. If we are going to join the race and win the prize there must be the highest development of American education at the top. The best men must be pushed to the front, and ample opportunities for growth, for investigation and for original research must be provided. Never has there been so large an opportunity for the man of large ideas, complete education and indomitable energy and purpose as there is to-day. The world is waiting, looking, longing for him, and will cry 'Make room' for him when he is found.

In the hands of the trustees of our colleges and hospitals are the money and the opportunity for developing such men. If the right spirit pervades both trustees and medical faculties and hospital staffs, then it will be but a short time before America will lead the world in medicine as well as she now does in commerce.

Will the profession rise to the level of their great opportunity? Yea, verily they will! Never yet have they been wanting when the emergency arose; not only the emergency of labor, but also the emergency of danger.

In Russia the common soldier counts for little. Yet in Vladikavkaz (where the Dariel Pass—the old Portæ Caspiæ of Herodotus—leading from the Caucasus joins the railroad from Baku on the Caspian to Moscow) is a monument to a common soldier. At the last battle in which the Russians won the victory over Schamyl which gave them undisputed sway over the Caucasus, this soldier blew up a mine and won the day at the cost of his own life. It was ordered that his name should never be erased from the list of his company. At every roll-call when his name is reached, the solemn answer is given 'Died in the service of his country.'

In our hospitals lurk the deadly breath of diphtheria, the fatal virus of bubonic plague, of cholera, of yellow fever, of typhus fever, and the ever present danger of blood poisoning. I have known of brother physicians who have died victims to each one of these scourges. Yet who has ever known one of our guild to shrink when danger smote him on the right hand and the left and death barred the way? As brave as the Russian soldier, ready to risk life, and, if need be, to lose it, these martyrs to duty shall never have their names stricken off the honor list, and at the last roll-call the solemn reply shall be, 'Died in the service of humanity.'

W. W. Keen.

Jefferson Medical College,
Philadelphia.

THE NEW MEDICAL BUILDINGS OF THE UNIVERSITY OF TORONTO.

THE new buildings for the department of physiology and pathology of the University of Toronto, which are to be formally opened in October next, are the first to exemplify the unit system of laboratory construction proposed by Professor Minot,* of Harvard University, and consequently an account of them may be acceptable to all who are interested in laboratory administration and construction.

The main features of the unit system, as outlined by Professor Minot, are all comprehended in the character of the laboratory 'unit' room. This must, first of all, be no larger than is required to accommodate readily the maximum number of students whose practical instruction a single demonstrator can efficiently guide and control. It must also be of such dimensions that it can, at need, be made to serve as a museum, a library or reading room, or a small lecture room. The units, further, must be so placed with respect to one another, preferably in pairs or series, that, by the removal of the partitions separating them, rooms of larger dimensions may, when desired, be obtained at a minimum cost and in a short time. The dimensions of such a unit, as determined by Professor Minot, are 23 x 30 feet, and this room will accommodate twenty-four working students, which number, experience shows, is the largest that should be under the supervision of a single class demonstrator.

The system, as may be seen, offers the great advantage of elasticity, for a laboratory director may enlarge or contract, at will, or according to the needs of the occasion, the accommodation required for a class, a feature that does not obtain in any other system of laboratory construction. It has also other and not less important advantages. The cost of construction is less than in any other system, it adequately provides for the all-important question of light, and it permits of subsequent extensions and additions without disturbance of the original arrangements. It is also to be noted that the system provides for the formation of smaller rooms through the division of the unit.

All these points were thoroughly canvassed when, nearly two years ago, the medical faculty of the University of Toronto took up the question of erecting new laboratory quarters for physiology, physiological chemistry, pathology and public health, and discussed the various plans of construction offered. The result was that the faculty unanimously recommended the adoption of the unit system for the proposed laboratories. The university trustees accepted the recommendation, and construction, begun in August last year, has progressed so rapidly that the buildings are completed and the equipment is now being put in. The whole is, therefore, at the moment in such a stage as to permit one to say to what extent the object sought has been attained.

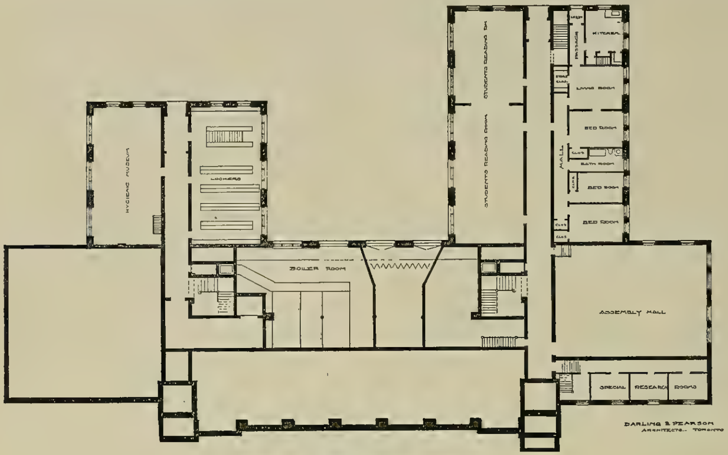
Architecturally, so far as the exterior is concerned, the utmost has been done, considering the difficulties that the enormous window space interposed. The appearance of the buildings, however, is, on the whole, very acceptable.

The interior, on the other hand, is very satisfactory. The accommodation it furnishes, as well as the conveniences of arrangement it offers, is sufficient to demonstrate the great advantages of the unit system over the common, more or less haphazard, system of laboratory construction everywhere illustrated.

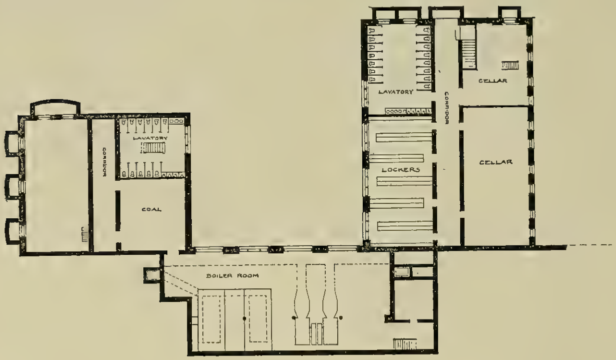
The buildings are to house physiology, physiological chemistry, pathology and

* *Philadelphia Medical Journal*, Vol. VI., p. 390, 1900; SCIENCE, Vol. XIII., p. 409, 1901.

public health. The wing to the right, as shown in the accompanying diagrams, accommodates physiology and physiological chemistry and contains, in addition to the lecture theaters, twelve units and eight half units. The other departments occupy the main portion and the left wing, which contains sixteen units and fourteen half units.



MEDICAL BUILDING TORONTO UNIVERSITY
BASEMENT PLAN.



MEDICAL BUILDING TORONTO UNIVERSITY
SUB-BASEMENT

DARLING & PEARSON
ARCHITECTS – TORONTO

In the construction of these buildings according to the unit system special local conditions had to be considered and, further, the possibility of their extension in a few years was a factor in determining the arrangement as a whole. This necessitated important modifications in the disposition of the units as suggested in Professor Minot's later paper.

What these modifications are may be gathered from examination of the copies of the plans of the various floors of the buildings. The latter are in the form of the

MEDICAL BUILDING TORONTO UNIVERSITY
GROUND FLOOR PLAN

figure ⊔, the lecture theaters forming wing-like extensions at the angles of the figure. This latter arrangement was adopted in order to permit the lecture rooms to be lighted from their roofs, and at the same time to avoid interfering with the light for the units. An additional advantage resulted from the arrangement in that the corridors, which are centrally placed, permit ready access to the lecture theaters and units from the entrances and from the students' quarters.

The units are, for the most part, grouped in pairs on each side of the corridors on the various floors. The walls of the corridors are of brick, but those which separate the units from each other are of wood and plaster only, and they can consequently be removed in a few hours without leaving traces of their disturbance other than those on the line of the fresh plaster added. Each unit communicates directly with its neighbor by a door, and, further, has two doors opening into the corridors. It is thus possible at any time to form two rooms out of a unit, each of which will communicate directly with the corridor.

The window space devoted to each unit is ample. It is, in fact, as large absolutely as the supporting capacity of the outer wall will safely permit. The window area is 242 square feet, while the outer wall of each unit measures 420 square feet.

The window area is, therefore, nearly three fifths that of the outer wall. The terminal units of the wings have additional window space in their second outer wall, and of course in these the lighting is brilliant. In all the other units, however, the lighting is, as already said, ample.

MEDICAL BUILDING TORONTO UNIVERSITY
SECOND FLOOR PLAN

MEDICAL BUILDING TORONTO UNIVERSITY
FIRST FLOOR PLAN

The corridors are lighted from the hall doors, from the large windows at the ends of the wings and from the wells over the

stairway. An examination of the building itself shows that this provides sufficient illumination with diffuse daylight, and even on very dull days it is enough for all except, perhaps, the main corridor extending between the two lecture theaters on the ground floor, and then resort may be had to electric lighting.

The two stairways are lighted from the roof, and are so placed as to permit the student reaching any floor directly from the basement, where the reading and writing rooms are situated. The locker rooms and lavatories, on the other hand, are in the subbasement and can only be reached from the basement corridor.

The wings are, including the basement and subbasement, five stories in height. The main portion is only three stories, if we leave out of account the boiler room. This arrangement is due to the fact that the rear part of the building is placed in a shallow ravine. White brick, with stone facings here and there, is the material; the roof is flat and bordered all round with a brick parapet.

The building is heated by air forced over heated coils by large fans driven by steam and the ventilation is thus, in part, provided for, and also by the exhaust currents in the ventilation turrets which rise over the entrances.

A feature of special interest is presented by the small research rooms. The half units are intended to be used for various purposes, but chiefly for small groups of students pursuing advanced work or for special lines of research, but each of the fifteen small rooms, shown in the plans as adjacent to the lecture theaters, is reserved for individual workers carrying on selected investigations. These, with the other arrangements described, have been designed with the view of making the buildings a home for research. A. B. MACALLUM.

SCIENTIFIC BOOKS.

A Laboratory Text-Book of Embryology. By CHARLES SEDGWICK MINOT. Philadelphia, P. Blakiston's Son & Co. 1903. Pp. 380. With 218 illustrations, chiefly original.

The past year has witnessed the publication of several manuals of embryology, among which may be mentioned: (1) The comprehensive and exhaustive 'Handbuch der vergleichenden und experimentellen Entwickelungslehre der Wirbeltiere,' edited by Dr. Oscar Hertwig, of which eleven Lieferungen have appeared to date; (2) Korschelt and Heider's 'Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thieren, allgemeiner Theil' in two parts; and (3) McMurrich's admirable 'Development of the Human Body.' The first furnishes the student with the only complete summary of the embryology of vertebrates published since Balfour's 'Comparative Embryology' appeared in 1881; in it the enormous mass of literature since that date is fully digested, and the results are presented in connected form, so that it may serve as a new starting point for the student of vertebrate embryology. In the general part of their text-book Korschelt and Heider furnish the long-promised completion of the special parts by a full treatment of the structure, origin, maturation and fertilization of the germ-cells, and the experimental embryology of invertebrates. McMurrich's book is an excellent brief treatise for the medical student of the main facts of human embryology. Minot's new book is a laboratory guide, mainly in the embryology of mammals. Thus the teacher of embryology is furnished with a fairly complete 'up-to-date' equipment of the literature in his subject for the use of his students.

Minot's laboratory text-book is written from the standpoint of the anatomist rather than of the biologist. In this point of view lie both its limitations and its excellencies. It is the outgrowth of the actual experience of one of the best known of the teachers of embryology, and hence is strongly individualized. Too much praise can not be given to the large number of new and beautifully executed

illustrations; a number of fine figures are transferred from the original sources to a text-book for the first time, and only the best of the stock illustrations of other text-books are retained. The book is, indeed, built up around the illustrations, and the text often suffers by comparison. The figures of reconstructions of the pig embryo of twelve millimeters neck-length are especially fine, as are also the figures of sections of this embryo and of other sizes. In all of these figures there is the most painstaking reproduction of details, and the accuracy of the work is equaled only by its beauty. The illustrations of the two stages of the chick embryo studied are also noteworthy for accuracy and finish.

The contents are arranged as follows: The first chapter deals with general conceptions, the second with the early development of mammals, and the third with the most general development of the human embryo. These chapters are introductory in their scope, without practical directions. The following chapters are practical; the fourth deals with pig embryos: beginning with the embryo of 12 mm., there follow in order, embryos of 9 mm., 6 mm., 17 mm. and 20 mm. The fifth chapter is a study of two stages of the embryo chick, with twenty-four somites, and with seven somites. In chapter six we have a study of the blastodermic vesicle of mammalia and of the segmentation of the ovum. Chapter seven deals with the uterus and the fœtal appendages of man, and chapter eight with methods.

Thus it will be observed that the student is led from a 12-mm. pig to a 9-mm. and 6-mm. stage, then by jumps to 20-mm.; from here a broad leap takes him to the youngest embryo yet studied, the chick of twenty-four somites, and he continues to descend by way of earlier stages of the rabbit, to the unsegmented ovum. This may fairly be termed *inverted embryology*. Professor Minot will not claim that this inverted order is logical, but only that is practical. It is a question of the pedagogy of embryology. Now it is safe to admit, that, for an anatomist who knows nothing of biology, the inverted method of studying embryology is likely to be the more comprehensible; and as most of our medical students are (crude) anatomists of this sort, it may be that their journey to embryological knowledge would subject them to fewer intellectual jolts if made by this road. It certainly is the historical highway by which the fathers of this science traveled; if recapitulation be the law in embryonic development, why not in embryological pedagogics?

It seems to me, however, to be an unwise concession to the present imperfect preparation of our medical students, and, in all seriousness, I believe an unnecessary concession; for my experience is that, after the first shock of exposure to biological conception and ideas, the medical student readily follows the cœnogenetic and logical method of proceeding upwards from the ovum. Moreover, the time is not far distant when every medical student will be required to have mastered the rudiments of biology before he shall be admitted to the study of that branch of applied biology known as medicine. With such a preparation the logical method is much better.

It is not, however, incumbent on the user to follow the order of the book, for the description of each stage is complete in itself. Those who use it, therefore, will probably follow their own ideas of order; and the practical parts can be unhesitatingly recommended as excellent in themselves.

The chapter on methods is rather brief, but good as far as it goes; a larger number of formulæ of killing fluids and stains and the methods of using them would undoubtedly be an improvement.

The three general introductory chapters are best, as is to be anticipated, in the parts allied to the author's own province of work; thus the 'law of genetic restriction' is well expressed and discussed; and the third chapter on the human embryo is by far the best brief outline of human development known to me. On the other hand, the unfortunate student who might have to derive his ideas on karyokinesis and on the maturation of the ovum from the vague accounts of this book, would probably conclude, for his own peace of mind, that these subjects are not of much importance after all. As regards the germ-layers in mammals we read on p. 59 that 'it is probable that

the subzonal layer is the ectoderm and that the inner mass is the entoderm,' whereas it is well established that the subzonal layer forms the ectoderm of the chorion (possibly also its mesoderm in some forms) only, and that the inner mass forms all of the tissues of the embryo proper as well as the yolk-sac. The mesoderm is described as arising by a process of delamination in birds, reptiles, elasmobranchs and mammals: 'It is safe to say that the mesoderm probably arises by this process, which we call delamination in all vertebrates' (p. 74). It would be difficult to make a more misleading statement concerning the origin of the mesoderm in vertebrates. The necessity for condensation affords no excuse, as the admirably clear, accurate and brief statement on the same subject in McMurrich's new manual demonstrates.

Such sweeping statements as the two following are at least regrettable: 'It is fortunate for our comprehension of embryological processes that we are already able to say that Roux's hypothesis is erroneous,' referring to the mosaic theory of the segmented ovum; we know, as a matter of *fact*, that certain ova (*e. g.*, of *Ctenophores*) are true mosaics; and the general bearing of recent embryological results is that all ova are more or less mosaic, in an unstable fashion. On page 41 we are told that Weismann's hypotheses are 'complicated' and 'useless'; not to mention the stimulus they have given to research, this sounds strange on the eve of a general rehabilitation of such hypotheses in connection with Mendel's laws of inheritance.

The book contains too many bad misprints and similar errors; *e. g.*, page 19: 'In mammals there are always four pairs (of gill pouches) *on each side*'; page 29, 'latter' for 'former' in the second line of the last paragraph; page 63, first line, Fig. 23 does not show the structure referred to; page 63, another erroneous figure reference in the second sentence of the last paragraph; page 91 'ectoderm' for 'entoderm' middle of page; page 105, 'unguiculate' for 'ungulate,' last sentence of third paragraph; page 113, 'three months' for 'three weeks,' second line from bottom of first paragraph. These are only a few instances of many.

Finally a protest should be entered against the use of the German word 'Anlage' to denote 'rudiment,' and especially against such a hybrid monstrosity as 'deck-plate' for 'roof-plate,' the first component being German and the second English.

FRANK R. LILLIE.

Handbook of Climatology. Part I., *General Climatology.* By Dr. JULIUS HANN, Professor of Cosmical Physics in the University of Vienna. Translated by ROBERT DECOURCY WARD, Assistant Professor of Climatology in Harvard University. New York and London, The Macmillan Co.

English readers interested in the climate of the earth will welcome the translation of the most important portion of the 'Handbuch der Klimatologie' by Dr. Hann, who now by general consent is accepted as the leading authority on this matter in the world. But the new English edition is more than a translation, and it would have been clearer had the title read translated and revised. Professor Ward has taken great pains to bring all the matter down to date. Besides his own large reading on the subject he has consulted such experts as Professor F. W. Very, Professor W. M. Davis and Professor R. W. Wilson, and then referred all criticism and suggested changes or additions to Dr. Hann, who has passed upon them or revised them, and thus given the weight of his authority to the matter, so that the book becomes essentially a revised edition including more American examples than the original. The preface says that, "Most of the examples given, however, necessarily still relate to Europe, because the climatology of that continent has been studied more critically than that of any other region. A few cuts have been made where the discussion concerned matters of special interest to European students only. Most of the paragraph headings are new, and the arrangement of parts, sections and chapters is somewhat different from that in the original. These changes have been made with a view to adapting the book better for use in the class-room. Every change that has been made has the full

approval of Professor Hann, who has been consulted in regard to all of these matters. Every reference, the original of which is accessible in the Harvard College library or in the library of the Harvard College Observatory, has been looked up, verified and made as complete as possible. No apology is needed for the use of the Centigrade and metric system in such a book as this. For convenience, conversion tables, reprinted from the Smithsonian Meteorological Tables, are given in the appendix."

Professor Ward has also taken great pains to have the book rendered into good English, and in this matter he has had the skilled hand of Professor Henry S. Mackintosh to assist him.

He has also taken great pains to add new references; and the book is remarkably rich as a bibliography to modern literature on climatology.

The book is divided into two parts. Part I. deals with the 'Climatic Factors,' namely, temperature, moisture, cloudiness, precipitation, winds, pressure, evaporation, composition of the atmosphere and phenological observations. Part II. deals with solar or mathematical climate, physical climate, the influence of land and water on the distribution of temperature, the influence of continents upon humidity, cloudiness, precipitation and winds, the influence of ocean currents upon climate, the influence of forests on climate, the mean temperature of parallels of latitude and of the hemispheres, mountain climate, and finally geologic and periodic changes of climate.

No less than five chapters are devoted to mountain climate and the influences of mountains on climate.

No one familiar with Dr. Hann's writings need be told that he deals with the subject from a cosmopolitan standpoint which is rare even among the leaders in science, and he shows a surprising familiarity with the literature of every language. The translation seems all that one could wish.

H. H. Clayton.

SCIENTIFIC JOURNALS AND ARTICLES.

The *Journal of Comparative Neurology* for April contains the following articles: 'The Fore-Brain of *Macacus*,' by Wm. Wolfe Lesem, a study of the superficial anatomy of the brain of the macaque monkey, with two plates. 'Brain Weights of Animals, with Special Reference to the Weight of the Brain in the Macaque Monkey,' by Edward Anthony Spitzka, including a tabulation of the brain and body weights of 204 specimens of mammalian brains. 'A Description of Charts showing the Areas of the Cross-sections of the Human Spinal Cord at the Level of each Spinal Nerve,' by Henry H. Donaldson and David J. Davis, an entirely new computation, including a comparison of the young and mature spinal cord and six different sets of curves. 'The Brain of the Archæoseti,' by G. Elliot Smith, a description of two casts of the brain cavity of this extinct cetacean, with four figures. There are twenty pages of book reviews, including a full summary of the researches of Professor Elliot Smith on the 'Phylogeny of the Pallium.'

SOCIETIES AND ACADEMIES.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The work of the society for the winter has maintained the high level of former years, as shown by the importance of the papers presented and the enthusiasm displayed. At the meeting of November 4, 1902, Professor Lester F. Ward discussed 'Race Differentiation and Race Integration,' treating the subject from the social side, and in this connection Professor Holmes showed diagrammatically the beginnings of races and their final amalgamation.

Professor W. H. Holmes followed with a paper entitled 'The Search for Glacial Man,' reviewing the various discoveries and describing the recent find of human remains at Lansing, Kansas. The meeting of November 4 was devoted to sociology, and papers were read by Mr. Charles F. Weller, on 'How Citizenship is Molded in Washington Alleys and Shacks,' and by Dr. George M. Kober, on 'The Abuse of Medical Charities.' These

papers set forth in an interesting manner the efforts being made to promote good citizenship. On December 2 Dr. D. S. Lamb read a paper on Rudolph Virchow, Miss Harriet A. Boyd gave a résumé of the important discoveries of the past few years in Crete, and Professor Holmes presented examples of Central American sculpture.

The twenty-fourth annual meeting was held on January 6, 1903, and the following officers were elected:

President—Miss Alice C. Fletcher.
General Secretary—Walter Hough.
Treasurer—P. B. Pierce.
Councilors—Dr. G. M. Kober, Dr. D. S. Lamb and F. W. Hodge.

At the following meeting of the board of managers there were elected:

Secretary to the Board—J. D. McGuire.
Curator—Mrs. Marianna P. Seaman.
Councilors—Hannah L. Bartlett, J. Walter Fewkes, Weston Flint, J. W. B. Hewitt, J. H. McCormick, J. D. McGuire, J. R. Swanton and Edith C. Wescott.
Vice-Presidents of the Sections—D. S. Lamb, Frank Baker, W. H. Holmes, J. Walter Fewkes, George M. Kober, W J McGee and Lester F. Ward.

At the meeting of January 20 a paper was read by J. Dyneley Prince and Mr. Frank Speck, on 'The Modern Pequots and their Language,' which was discussed by Dr. A. S. Gatschet, who remarked that this paper contains almost all we know about the vanishing Pequots. The general secretary read a paper entitled 'The Gypsy,' which brought out general discussion.

At the meeting of February 3, the retiring president, W. H. Holmes, delivered his annual address under the auspices of the Washington Academy of Sciences, the subject being 'A Genetic View of Man and Culture.' The scope of the science of anthropology was defined and the limitations and relations of its various branches considered. By means of diagrams, the genetic relations of the various groups of physical, mental and cultural phenomena were indicated, and the methods of research in the various fields and the manner of applying the knowledge acquired to the elucidation of human history were discussed.

At the meeting of February 17 Dr. John R. Swanton's paper on 'The Religion of the Haida Indians' gave voluminous information on a subject almost entirely untouched, heretofore. The second paper, by Mr. C. A. Simms, described a wheel-shaped monument discovered by him in Wyoming.

At the meeting of March 4, under the head of varieties, Dr. G. M. Kober read an extract from *American Medicine* on 'Hereditary Pauperism'; Professor Holmes gave details as to the new museum building; the president, Miss Fletcher, read a letter from Dr. G. G. MacCurdy in response to an inquiry concerning the course of anthropology at Yale, and remarked on Dr. Codrington's observations on the stability of unwritten language based on the Solomon Islanders, whose vocabulary has had no change in 300 years; she also announced the death of Mrs. Mary L. D. Putnam, of Davenport, Iowa.

Professor L. F. Ward followed with a paper on 'The Cross-fertilization of Cultures.' He dealt with origins, tracing the course of two or several independent human nuclei up to the point of meeting and contact, which, according to circumstances, determined peaceful or warlike races. He traced the origin of the state through militancy by various stages until conquerors and conquered are united under a war chieftain who is depended on, thus giving stability. Then races mix on the line of contact between the conquerors and conquered, forming a people, and we have cross-fertilization of races. In discussion, Professor Holmes said that we can now almost safely go back along the lines marked out by Professor Ward and depict pre-man.

In the next paper, by Dr. J. H. McCormick, on 'Prehistoric Remains of Mobile Bay,' the ancient mounds and sites of historic interest in the locality were described.

At the meeting of March 17 the president read a communication from Mr. Hill Tout, giving the aims of the Ethnographic Survey of Canada, of which he is secretary, and commented on the plan.

Professor M. D. Learned, of the University of Pennsylvania, read a paper entitled 'An Ethnological Survey of the United States.' Professor Learned noticed the efforts of the Germans, English and Americans in this matter, and announced that a bill for an ethnographic survey of Pennsylvania is pending in Harrisburg. This bill grew out of a test survey called the Conestoga Expedition of 1902, through which a great mass of valuable material was gathered. Professor Learned said that the character of the investigation should be a culture census of the American people, and agreed that, owing to the magnitude of the task, it should be undertaken by the census office. The paper was discussed by W. H. Babcock, Dr. H. C. Bolton, George R. Stetson, Professor Alexander G. Bell, Mrs. M. C. Stevenson, Dr. D. S. Lamb and E. S. Hallock.

The paper by Dr. I. M. Casanowicz, entitled 'Græco-Roman Papyri in the United States National Museum,' described the making of paper from the papyrus reed, the size of the books in the collection, their character as accounts, ledgers, letters, etc. Translations of a number of these Fayum papyri were given.

At the meeting of March 31 the president announced that Professor Brigham, of Honolulu, had succeeded in taking phonographic records of the intoned 'olas' or sagas of the Hawaiians, from the few old men who preserved these sacred chants.

The paper of the evening, 'Indian Baskets: What they are and What they mean,' was presented by Dr. C. Hart Merriam. The subject was illustrated with numerous specimens from Dr. Merriam's large collection and by many lantern slides. It was pointed out that the basket-making tribes to-day are confined to the regions west of the Rocky Mountains. The materials, the forms and uses of baskets, the environment, the state of the art and other topics were discussed and the patterns, so far as they have been determined, were explained. Dr. Merriam said that he had found the butterfly pattern in use among widely separated tribes, who give it the same meaning.

Walter Hough,
Secretary.

AMERICAN MATHEMATICAL SOCIETY.

A regular meeting of the American Mathematical Society was held at Columbia University, Saturday, April 25. About fifty persons, including forty members of the society, attended the two sessions. The president of the society, Professor Thomas Scott Fiske, occupied the chair. The following new members were elected: Professor William N. Ferrin, Pacific University, Forest Grove, Ore.; Mr. Ernest H. Koch, Jr., Mackenzie School, Dobbs Ferry, N. Y.; Professor Norman C. Riggs, Armour Institute of Technology, Chicago, Ill.; Mr. K. D. Swartzel, Harvard University. Twelve applications for membership were received.

Sectional meetings of the society were held at Northwestern University, April 11, and at Stanford University, April 25. Reports of these meetings will appear separately in Science.

The university subscriptions in support of the *Transactions* which have expired have been renewed, except that Wesleyan University now takes the place of Princeton in the list of supporting institutions.

While the activities of the society are concentrated on the promotion of mathematics as a science, it is inevitable that through its large and representative membership it should ultimately exert a considerable and beneficial influence on the teaching of mathematics in schools and colleges. As a scientific body, the society does not promulgate official views on any subject, but merely furnishes a forum for discussion. That it does not endorse any particular conclusion is not, however, by any means inconsistent with the collection and digestion of useful information. At present three several committees of the society are actively engaged in the preparation of reports on requirements in mathematics for the master's degree, on college entrance requirements in mathematics, and on desirable relations of the society to the teaching of elementary mathematics, respectively. The society has recently been greatly interested in a movement, foreshadowed in Professor E. H. Moore's presidential address (*vide* Science, current

volume, pp. 401–416), which is taking effective shape in the organization of associations of teachers of mathematics throughout the country. On April 11–12 the Central Association of Teachers of Mathematics and Science was formed at Chicago, Professor Moore and other members of the society actively cooperating. At a meeting held in Boston on April 18 the Association of Teachers of Mathematics in New England was organized. This meeting was opened by an address, by President Thomas S. Fiske of the society, on 'Methods for improving the teaching of mathematics.' Other similar associations will probably soon be formed. It is precisely through such associations that the society can best exert a real influence on the teaching of mathematics.

The following papers were read at the April meeting:

H. E. HAWKES: 'On non-quaternion number systems in seven units.'

B. O. PEIRCE: 'On families of curves which are the lines of certain plane vectors, either solenoidal or lamellar.'

E. W. BROWN: 'On the variation of the arbitrary and given constants in dynamical equations.'

L. P. EISENHART: 'Congruences of tangents to a surface, and derived congruences.'

H. F. STECKER: 'Least distance in the non-euclidean plane.'

L. E. DICKSON: 'Fields whose elements are linear differential equations.'

SAUL EPSTEEN: 'On linear differential congruences.'

R. S. WOODWARD: 'The deviation from the vertical of falling bodies.'

EDWARD KASNER: 'The automorphic groups of the manifolds defined by a general and a symmetric determinant.'

C. H. SISAM: 'On some directrix curves on quintic scrolls.'

L. I. NEIKIRK: 'Groups of order p^m which contain cyclic subgroups of order p^{m-3}.'

I. M. SCHOTTENFELS: 'On the simple groups of order $8!/2$.'

E. B. WILSON: 'The so-called foundations of geometry.'

The American Physical Society was in session simultaneously with the Mathematical Society. While it was found impracticable to arrange a joint session, several members of the Physical Society attended the presentation of Professor R. S. Woodward's paper. In the evening twenty-five members of the two societies dined together and continued the discussion of the outlook for the better teaching of mathematics, a topic of mutual interest and importance.

The next meeting of the Mathematical Society will be the summer meeting, which, with the Fourth Colloquium, will be held at the Massachusetts Institute of Technology, Boston, beginning August 31. F. N. COLE,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE PROPOSED BIOLOGICAL LABORATORY AT THE TORTUGAS.

THE need of a first-class marine laboratory for research in the tropical Atlantic is so apparent and so pressing that I hope that no apology is necessary for a few practical suggestions that are the result of a personal acquaintance with the station that seems, from the replies to Dr. Mayer's enquiries, to be the one most favored by the zoologists who have been consulted. Without any intention of belittling the claims of any other situation, there are certain important advantages that can be urged in favor of the Tortugas that seem to render this station far and away the most advantageous for the best work along marine biological lines. These may be summarized as follows:

1. The unexcelled fauna. It seems to me that there is hardly a doubt that at no point in the vicinity of our southern coast are the conditions more favorable for profuse marine life than here. Some years ago an expedition from the University of Iowa examined with some care several regions in the West Indies and Florida keys, including the island of Eleuthera, Cuba, Key West and the Tortugas. While any one of these stations would afford abundant material for investigation, the preeminence can confidently be claimed for the last of these points. As asserted by Dr. Mayer, the northern edge of the Gulf Stream seems to very materially excel the southern, especially in the matter of pelagic life.

The extensive reefs and flats abound in almost all groups of marine invertebrates that belong to the West Indian fauna, and are easily accessible from Garden Key, where the proposed station would logically be placed.

2. The unusual purity of the water. This is a condition that will appeal to any one who has had much experience with marine work. There being no city or even town in the immediate neighborhood is a decided advantage from this standpoint. Even at Naples, which is now probably the best station in the world, there are many forms that are not successfully kept for any length of time in the aquaria. When the writer was at Plymouth, England, some years ago, the water, although apparently pure, was the cause of much perplexity and discouragement. At the Woods Hole laboratories the condition is even worse, and many problems have to be abandoned that could be solved with the aid of such water as could easily be secured at the Tortugas. While it may be claimed that equally pure water could be obtained at other points in the West Indies, I know of no place where it would be so easily introduced into a laboratory. The ship channel runs right by the old quarantine station on Garden Key, and practically no piping would be necessary to utilize it for laboratory purposes.

3. By far the largest and best stocked aquarium in the world is already established there in the form of the old moat that was of course originally designed to serve quite different purposes. This moat is protected by a solid wall of masonry that at the time of our visit was practically intact and good to serve for many years. The opposite side of the moat is the solid wall of old Fort Jefferson. I do not remember the width of the moat, but it must be at least thirty yards, judging from a photograph taken by myself. It is from three to six feet deep, the water is changed at every tide, and its surface is always quiet, except when an unusually heavy storm throws the spray over the outer wall. Here are conditions such as can nowhere else be found. During nearly half a century this moat has been practically undisturbed by man, and has been populated with an extremely rich fauna of its own. Here many species of marine animals and plants can be watched daily and hourly, if need be, throughout their lives, and under perfectly natural conditions. Portions of the moat could easily be divided off for particular purposes by the use of wire screens. The breeding and development of many species could be carried on under scientific control, and the results would not be vitiated by the objections so constantly raised concerning the unnatural conditions of many of the present laboratory experiments.

4. Nearness to the Pourtales Plateau. This submarine shelf made famous by the wonderful results of the dredging done by the *Blake* and other vessels lies within easy reach of the Tortugas. This would give an excellent opportunity to investigate forms of a comparatively deep-water zone in a region probably unexcelled in richness of fauna by any other in the western hemisphere.

It is improbable that deep-water work is contemplated by those having charge of the movement for a laboratory in this region, but there is no reason why excellent work should not be done in this direction. We were perfectly successful in dredging on the plateau with a small schooner, with iron rope and an ordinary windlass worked by hand power. Indeed, it was here that we met with our best success.

5. An abundance of building material. This is already on the spot and could doubtless be secured for scientific purposes without any cost whatever. Fort Jefferson was originally one of the most extensive fortifications in the United States, but it is now crumbling into ruins. Some parts of the buildings could doubtless be repaired at little cost to serve the purposes of the station, and there are millions of brick and quantities of stone that are serving no purpose whatever. I understand that all this is now in the hands of the U. S. Army, but it could surely be secured for such a purpose as is contemplated if the matter were fairly presented to the proper authorities.

Another very important matter in this connection is the large supply of excellent drinking water stored away in the immense cis-

terns, originally intended to serve for a supply for thousands of men. Any one who has worked in tropical regions will appreciate what it means to have abundant fresh water that is good and sweet and cool. This, together with the absence of mosquitoes, would be a very forceful argument in favor of the Tortugas with naturalists of experience in warm regions.

Of course it is possible that some of the conditions have changed since the writer visited the Tortugas. For instance, the moat may have become partly filled up, or the channel may have changed so as to block the way to the old quarantine building. But it does not seem likely that conditions are greatly different from those described above, or that the changes are such as materially to modify the advantages of that locality for a marine biological laboratory. It has been my purpose to mention particularly certain advantages that would not occur to one not acquainted with the local situation, and it appears to me that these considerations are of unusual weight in the present case.

Taking into consideration the whole body of American workers that could use such a station to advantage, it can hardly be said that the Tortugas are less accessible than the other localities suggested in the letters published by Dr. Mayer, *i. e.*, the Bermudas or Jamaica. For those living in the central or western states the Tortugas are more accessible than either of these. Of course if a station were established at the Tortugas, it should possess its own means of transferring workers and supplies to the mainland.

C. C. NUTTING.

STATE UNIVERSITY OF IOWA,
May 2, 1903.

I AM asked whether I approve or disapprove of the plan to establish a marine biological laboratory for research in the tropical Atlantic. Considered solely with reference to the good of science, it is impossible to see how any biologist could disapprove such a plan. Thus viewed, the only room for discussion would seem to be as to what the aims of such a laboratory should be. But even here it seems to me there should be little hesitation, so far, at least, as generalities are concerned. The proposed laboratory should, of course, aim to provide facilities for any investigator, at any time, to carry on any investigation for which the opportunities furnished by nature should be good. This general purpose requires no advocating, since it is essentially one that has been held by most, if not all, American marine laboratories, and hence would probably be foremost with this.

What does need urging, it seems to me, is that this new laboratory should not limit itself to this purpose. In addition to its being a laboratory where anybody can do any kind of work in which he may be interested, let it have an aim of its own, as a laboratory. Let it set for itself the task of investigating the sum total of the life and the life conditions of the area in which it shall be located. Let it undertake a biological survey of the region. This will require organized, continuous and long-continued effort.

In no American seas is there being biological work done in any way comparable with what, for example, Scandinavian and German naturalists are doing in the North and Baltic seas, and the Liverpool biological committee is doing in the Irish sea. Yet whether regarded from the strictly scientific point of view, or from the point of view of the economic interests of marine life, few aspects of biology promise surer and more important results than do investigations of this sort.

The work done by our seaside laboratories has been altogether too narrow, and the foundation of a new one in the tropical Atlantic would be a peculiarly favorable opportunity to broaden out. WM. E. RITTER.

UNIVERSITY OF CALIFORNIA,
May 3, 1903.

TO THE EDITOR OF SCIENCE: The plan to establish a marine biological laboratory in the tropical Atlantic is one of which I am heartily in favor.

Although I have never visited the Tortugas, I have received many interesting collections from there and appreciate their wealth of characteristic coral-reef fauna. At some

future time, a comparison of the fauna of this region with that of the life of similar reefs in Samoa or Tahiti would be highly instructive.

Surely there can be no place on our Atlantic coast which would give handsomer returns for such an outlay. The only objection is the relative inaccessibility of the Tortugas.

David S. Jordan.

SHORTER ARTICLES.

SOME LITTLE-KNOWN BASKET MATERIALS.

Basket collectors have been much puzzled over the identity of two materials which are extensively used by some of the California tribes. One of these forms the body surface of most of the coiled baskets made by the Indians inhabiting the lower slopes of the Sierra from Fresno River south to the Kern. These baskets are celebrated for excellence of workmanship, beauty of form, elegance of design and richness of material. The material differs in tone and texture from that used by the tribes north and south of the region indicated. When fresh its color is brownish-buff; with age it becomes darker and richer. By careful selection a handsome dappled effect is produced. The Indians told me it was the root of a marsh plant which they traveled long distances to procure. After some difficulty I succeeded in obtaining specimens, which were identified for me by Miss Alice Eastwood, botanist of the California Academy of Sciences, as *Cladium mariscus*. The coil, around which the split *Cladium* root is wound, consists of a bundle of stems of a yellow grass, *Epicampes rigens*. The black in the design is the beautiful root of the 'bracken' or 'brake fern,' *Pteridium aquilinum*. The red is usually split branches of the redbud, *Cercis occidentalis*, with the bark on, gathered after the fall rains when the bark is red. The tribes making the *Cladium* baskets are the Nims, Chukchancys, Cocahebas, Wuksaches, Wiktchumnes, Tulares and perhaps one or two others. Besides these, the root is sometimes used by certain squaws of the Mewah tribe living north of the Fresno, and by the Pakanepull and Newooah tribes living south of the Kern; but among these its use is exceptional.

Another material which has proved a stumbling block to collectors is the red of the design in the handsome baskets made by the Kern Valley, Neewooah, and Panamint Shoshone Indians. This material is often called 'cactus root,' but in my recent field work in the region where it is used I discovered that it is the unpeeled root of the tree yucca (*Yucca arborescens*). The tree yucca grows in the higher parts of the Mohave Desert, pushes over Walker Pass, and reaches down into the upper part of the valley of South Fork of Kern. The so-called Tejon Indians obtain it in Antelope Valley at the extreme west end of the Mohave Desert. The yucca root varies considerably in depth of color, so that by careful selection some of the Indian women produce beautiful shaded effects and definite pattern contrasts.

Some of the Panamint Shoshones inhabiting the desolate desert region between Owens Lake and Death Valley use, either in combination with the yucca root or independently, the bright red shafts of the wing and tail feathers of a woodpecker—the red-shafted flicker. These same Indians use two widely different materials for their black designs—the split seed pods of the devil's horn, *Martynia*, and the root of a marsh bulrush, *Scirpus*. The *Martynia* is a relatively coarse material and when properly selected yields a dead black. The *Scirpus* root is a fine delicate material which, by burying in wet ashes, is made to assume several shades or tones, from blackish-brown to purplish-black, or even lustrous black.

In parts of the Colorado Desert in southeastern California the Coahuila Indians use split strands from the leaf of the desert palm (*Neowashingtonia filamentosa*) as a surface material for their coiled baskets. The design is usually black or orange-brown and is a rush (*Juncus*).

C. Hart Merriam.

A NOTE ON PHRYNOSOMA.

In 'The Cambridge Natural History,' Vol. VIII., on 'Amphibia and Reptiles,' by Hans Gadow (London, 1901), on p. 533, regarding

the genus *Phrynosoma*, the author says, 'All the species are viviparous, almost the only instance among Iguanidæ.'

This statement, which is as given in the older works on reptiles, does not apply to *Phrynosoma cornutum* of Texas, as I showed in my 'Notes on the Biology of *Phrynosoma cornutum* Harlan' in the *Zoologischer Anzeiger*, No. 498, 1896 (also SCIENCE, N. S., Vol. III., No. 73, pp. 763–5). In that paper I described the nest building and ovulation for the above species.

As pointed out by R. W. Shufeldt in SCIENCE, September 4, 1885, pp. 185–6, and later SCIENCE, N. S., Vol. III., No. 76, pp. 867–8, June 12, 1896, *Phrynosoma douglassii* is viviparous, so that the genus *Phrynosoma* contains both oviparous and viviparous species.

CHARLES L. EDWARDS.

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A NOTE ON NOMENCLATURE.

Festuca spicata Pursh. Fl. Am. Sept. 83. 1814.

Agropyron divergens Nees in Steud. Syn. Pl. Glum. 347. 1855.

A. spicatum Rydb. Mem. N. Y. Bot. Gard. 1: 61. 1900 (Cat. Fl. Montana).

Agropyron glaucum occidentale Scribn. Trans. Kan. Acad. Sci. 9: 119. 1885.

Agropyron spicatum Scribn. & Smith, Bull. U. S. Dept. Agric. Div. Agrost. 4: 33. 1897.

Agropyron Smithii Rydb. Mem. N. Y. Bot. Gard. 1: 64. 1900 (Cat. Fl. Montana).

Agropyron occidentale Scribn. U. S. Dept. Agric. Div. Agrost. Circ. 27: 9. 1900.

Festuca spicata Pursh.

"F. spiculis alternis sessilibus erectis subquinquefloris, floribus subulatis glabriusculis, aristis longis scabris, foliis linearibus culmoque glabris.

"On the waters of Missouri and Columbia rivers. June. v. s. in Herb. Lewis."

Steudel published '*Triticum divergens* Nees. (mpt. sub. *Agropyrum*)' based on a plant collected by Douglas. This is the common wheat grass of the Northwest, usually with long-awned spikelets.

Another common species of the Great Plains, often called blue joint or blue stem, had for years been identified with *A. repens* Beauv. or *A. glaucum* R. & S. of Europe. In 1885 Professor Scribner made this a variety (*occidentale*) of the latter European species. Twelve years later Scribner and Smith, in their review of the genus *Agropyron*, raised this to specific rank, but with the name *A. spicatum*, as they believed it to be the same as Pursh's *Festuca spicata*.

Mr. Rydberg, having examined Lewis's specimen in the Herbarium of the Philadelphia Academy, decides that *Festuca spicata* Pursh is identical with *Agropyron divergens* Nees and, following the Rochester Code, renames the plant *A. spicatum* Rydb. But there was already the *A. spicatum* S. & S., which must receive a new name, *A. Smithii* Rydb. Then Professor Scribner calls attention to the earlier varietal name *occidentale*, which must be taken up, and we have *A. occidentale* Scribn., or more consistently, if the parenthesis is used in citations, *A. occidentale* (Scribn.) Scribn.

If a later botanist examines the type and decides that it is *A. Vaseyi* Scribn. & Smith or some other species, another change must ensue. It seems to be a case of he laughs best who laughs last.

The object of reciting this piece of nomenclatorial history, which might be duplicated many times, is to point out the mischief which arises from allowing a specific name to have priority over a binomial. I am not sure that the Rochester Code compels this, but it seems to have been so interpreted by many botanists.

Rule 3, as given in Britton and Brown's 'Illustrated Flora,' states that: 'In the transfer of a species to a genus other than the one under which it was first published, the original specific name is to be retained.' This is unequivocal, as no exceptions are made. Rule 5 seems to prohibit the use of *Agropyron spicatum* for any species later than that to which it was first applied. (Rule 5: 'The publication of a generic name or binomial invalidates the use of the same name for any

subsequently published genus or species, respectively.')

It may be that the 'subsequently published species' refers to the application of an original specific name and not a binomial. But Rule 7 says: 'Publication of a species consists only * * * (2) in the publishing of a binomial, with reference to a previously published species as a type.'

While it is not my object here to advocate any particular set of rules, but only to point out the way these rules work in practice, I would observe that in the above case:

1. The use of the original specific name, when the identity of *Festuca spicata* Pursh is discovered, gives us two new names, *Agropyron spicatum* Rydb. and *A. Smithii* Rydb. This must always occur when the displaced binomial has no earlier synonym, and even when there is an earlier available name there results a change of names.

2. If a binomial has precedence over the specific name, that is, if in transferring a species to a different genus, the earliest specific name is used except where this specific name already occurs, there is not more than one new binomial. In the case under consideration, as there is already an *Agropyron spicatum* S. & S., if *Festuca spicata* Pursh is transferred to the genus *Agropyron*, it would ordinarily be given a new binomial, but as the name *A. divergens* Nees has been applied to the same species, no new binomial is necessary.

3. If the earliest specific name which the plant has received in a given genus is used, the so-called Kew rule, no subsequent changes are necessary, so long as the plant is assigned to this genus. Subsequent investigations regarding earlier names under other genera may add to our knowledge, but will not alter the binomials. From the standpoint of stability the maximum would appear to result from following the third method.

A. S. Hitchcock.

REMAINS OF ELEPHANTS IN WYOMING.

I am not aware that any elephant remains have ever been reported from Wyoming, and for this reason wish to make a record of the following notes: During the fall of 1894 Mrs. Dover, of Dover P. O., Albany Co., discovered the lower jaw of a very small elephant in Halleck cañon, which is about forty-five miles north and east of Laramie. The fossil was covered with a thin coating of earth in the valley wash, and not petrified. It was badly taken up, and by the time it reached me was very fragmentary. The front of the jaw has been well preserved and the right molar is nearly complete. The jaw and teeth are exceptionally small and probably indicate a new species. It is interesting to note that this specimen was found at an elevation of about 6,500 feet above the sea. The remains have been donated to the university, and in due time will be described.

Three years ago, while at work in the Goshen Hole region, I found an elephant's tusk that had been cut in two by a cattle trail that was not over a foot in depth. The tusk was over six inches in diameter. No doubt there is more or less of an animal at this place; but no attempt has been made to unearth it.

While at Casper a few years ago a stockman described a tooth which one of his riders had brought into his ranch, and which he had sent east as a present to a friend. From his description it must have been a very large tooth of an elephant. While this datum has little if any value, yet it is quite certain that an animal or a portion of an animal was found in that region.

To this I wish to add another note, which, although not in connection with Wyoming data, adds some important information to this subject. Two years ago, while at work near Fossil, a collector brought to me a beautiful elephant's tooth of unusual size. He informed me that he had taken it from the bottom of a well very near Bear Lake, Utah. This well was about twenty feet in depth and the tooth was found in rather fine gravel. The tooth belonged to *E. primigenus*, judging from its size and the arrangement of the plates. It is interesting to note that the elephant lived at rather high elevations, as well as along the streams of the plains and the lower areas of North America. It is also

quite probable that there were highland or mountain species that have not been described. WILBUR C. KNIGHT.

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CURRENT NOTES ON METEOROLOGY.

SNOW CRYSTALS.

MENTION has already been made in these notes of the micro-photographic study of snow crystals which has been carried on for twenty years by Mr. W. A. Bentley, of Vermont. In the 'Annual Summary' of the *Monthly Weather Review* for 1902 (dated March 16, 1903), Mr. Bentley has a further contribution to this subject, in which he gives the results of his studies of snow crystals during the winter of 1901–02. The classification proposed by Hellmann ('Schneekrystalle,' Berlin, 1903, p. 38) is adopted as the best. It has been found that in general the great majority of perfect crystals are produced in the western, southwestern or northwestern portions of widespread snowstorms. The whole number of photographs of individual crystals taken by Mr. Bentley is now somewhat over 1,000, and no two are alike. This is doubtless the most complete collection in the world. The article contains 22 plates giving half-tone reproductions of 255 separate snow crystals—altogether a most beautiful collection.

STRUCTURE OF CYCLONES.

THE January number of the *Monthly Weather Review* contains a paper by Professor F. H. Bigelow on 'The Structure of Cyclones and Anticyclones on the 3,500-foot and 10,000-foot Planes for the United States.' In this paper charts are given showing, for the cyclones of January 2 and 7, 1903, the distribution of pressure and temperature at sea level, at 3,500 feet and at 10,000 feet. In reducing the station observations of pressure and temperature to the two high-level planes, Professor Bigelow used the tables prepared by him and published in his report on Barometry, a brief note on which appeared in SCIENCE for April 10, page 595. As Professor Bigelow says, these charts 'have special interest from the fact that this is the first exhibit of the isobaric systems in the upper air surrounding individual cyclonic and anticyclonic centers.'

R. DEC. WARD.

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BOTANICAL NOTES.

A NEW CLASSIFICATION OF PLANTS.

IN his new syllabus of the plant-families ('Syllabus der Pflanzenfamilien,' 1903), Engler makes a considerable modification of the system of plants which he has followed heretofore. In the edition of the 'Syllabus' which appeared in 1898, four branches ('Abteilungen') of the vegetable kingdom were recognized, as follows: (1) Myxothallophyta, (2) Euthallophyta, (3) Embryophyta Zoidiogama, (4) Embryophyta Siphonogama. The changes in the new edition consist in breaking up the Euthallophyta into ten branches, thus increasing the whole number from four to thirteen. This very materially changes the grouping of the algæ and fungi which make up the bulk of the Euthallophyta. The branch Myxothallophyta remains unchanged, except in minor details as to group names, and the same is true of Embryophyta Zoidiogama and Embryophyta Siphonogama.

The new grouping is as follows:

Branch ('Abteilung') 1. PHYTOSARCODINA (Myxothallophyta), with three classes, Acrasiales, Plasmodiophorales and Myxogastres.

Branch 2. SCHIZOPHYTA, with two classes, Schizomycetes and Schizophyceae.

Branch 3. FLAGELLATAE.

Branch 4. DINOFLAGELLATAE.

Branch 5. ZYGOPHYCEAE, with two classes, Bacillariales and Conjugatae.

Branch 6. CHLOROPHYCEAE, with three classes, Protococcales, Confervales and Siphoneae.

Branch 7. CHARALES.

Branch 8. PHAEOPHYCEAE.

Branch 9. DICTYOTALES.

Branch 10. RHODOPHYCEAE, with two classes, Bangiales and Florideae.

Branch 11. EUMYCETES, with five classes, Phycomycetes, Hemiascomycetes, Euascomycetes, Laboulbeniomycetes and Basidiomycetes.

Branch 12. EMBRYOPHYTA ASIPHONOGAMA, with two subbranches ('Unterabteilungen') as follows:

Subbranch Bryophyta, with two classes, Hepaticae and Musci.

Subbranch Pteridophyta, with four classes, Filicales, Sphenophyllales, Equisetales and Lycopodiales.

Branch 13. Embrophyta Siphonogama, with two subbranches, as follows:

Subbranch Gymnospermae, with six classes, Cycadales, Bennettitales, Cordiatales, Ginkgoales, Coniferae and Gnetales.

Subbranch Angiospermae, with two classes, Monocotyledoneae and Dicotyledoneae.

The significance of this rearrangement consists in the recognition of the greater relative importance of the lower groups of plants. There was a time, not many years ago, when eminent botanists regarded the flowering plants (Phanerogams) as coordinate with the lower plants bunched into one group (Cryptogams). Next, four groups—Thallophyta, Bryophyta, Pteridophyta and Spermatophyta —were recognized, the flowering plants (Spermatophyta) representing but one of the four great types of plants. Now we find in Engler's latest grouping that Spermatophyta are coordinate, not with one, or three, but with *twelve* other groups. This means that we no longer regard the morphological differences among lower plants as of merely secondary importance, but accord to them a value equal to that which they have in the flowering plants.

While one may bring serious objections to many details in this new system, there can be no doubt as to its usefulness in calling attention to the morphological differences among lower plants. In the consideration of the characters upon which the classification of plants depends botanists have generally given too much weight to those of flowering plants, and too little to those of the lower plants. This has made our systems top-heavy. In recent years tardy justice has been given to the fernworts (Pteridophyta) and mossworts (Bryophyta), but as for the fungi, lichens and algae, they have been thrown into a common heap of the 'thallus plants' (Thallophyta), in spite of the fact that they represent several well-marked great types. This mistake, at least, has not been made in Engler's new system. Here the lower types receive full recognition, and the higher are thereby reduced to something like their proper relative rank.

MORE MARINE BOTANY.

A few weeks ago mention was made of the opportunities for seaside laboratory work in botany at Woods Holl, Sandusky and on Vancouver's Island. To this list should be added the Biological Laboratory at Cold Spring Harbor, on the north shore of Long Island, which will be opened for its fourteenth session this year from the middle of June to the middle of September or later for investigators. There will be lectures from July 1 to August 15. In botany, courses are offered in cryptogamic botany, ecology and bacteriology. For a small number of investigators there are private laboratory rooms which may be obtained free of charge on certain conditions. Professor C. B. Davenport, of the University of Chicago, is the director.

AIDS TO THE STUDY OF THE FUNGI.

Professor Kellerman, of the Ohio State University, Columbus, is doing two things which will do much toward helping to increase the study of the fungi. The first is intended for the scientific worker, and consists of alphabetical lists of articles, authors, subjects, new species, hosts, new names and synonyms pertaining to North American fungi. Two such lists have appeared, the first representing the mycological literature of the year 1901, covering fifty-seven pages, and including nearly 1,000 citations, and the second representing the literature for 1902, and including about 1,400 citations. These lists are printed on one side of the page only, and so may be cut for card cataloguing purposes. The amount of work which these lists represent is quite appalling, and one can only wonder at the courage of the professor in undertaking it. That it will be of the greatest value to students of the fungi is at once obvious.

The other undertaking of the professor is the publication of a four-page leaflet under the title *Ohio Mycological Bulletin* for the benefit of beginners and amateurs in the study

of the fungi. It is to be issued 'from time to time,' and is sent for the nominal charge of ten cents for the year. All who send this sum are enrolled as members of the 'Ohio Mycological Club,' and from the lists already published this club is certainly a very live and active one, since it enrolled nearly 150 names in less than a fortnight. While intended for the beginner, these bulletins, of which two numbers have been issued, are of interest to the worker as well. Professor Kellerman is to be congratulated upon having so successfully launched this useful little publication.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

CORNELL WORK FOR AGRICULTURE.

THE president of Cornell University in a recent address before the College of Agriculture of that university gave a very admirable summary of the work of the college and its relations with the state.

The college was founded under the Land Grand Act of 1862 and is, under that act, a state college; but the state of New York has done nothing for it until within a few years, and the annual expenditures of the university on free scholarships for the state have exceeded the sum total of all the contributions of the state to the work. This address refers mainly to the work of the college and of the university in scientific fields and in promotion more or less directly of the agricultural interests of the state.

The university provides about eight hundred scholarships at a cost of about $250,000 per annum. Of these, six hundred are distributed to the one hundred and fifty assembly districts of the state. They are 'state scholarships.' The others are open to all and secured by competitive examinations. The annual cost of the College of Agriculture is $141,-061.27, as for the last fiscal year 1901–1902.

The state of New York does not appropriate a dollar of this nearly $400,000. It makes appropriations for the state colleges of forestry and of veterinary science, located at Cornell University but not its property, $35,-000. It turns over to the university the less than $60,000 per annum coming in from the Land Grant Fund, which fund was the gift of the United States. It has built two buildings, which, however, remain the property of the state.

The College of Agriculture of Cornell University gives free tuition and has done so from the first. The students in regular course number about two hundred. There are enrolled in the Farmers' Reading Course 30,000 students; in the Farmers' Wives' Reading Course, 8,000; in the 1700 Junior Naturalists' Clubs, 30,000; in the Home-Study Courses about 15,000 teachers. Five hundred farmers have conducted experimental work on their own farms, under the supervision of the college. A correspondence school of large extent is carried on, which gives instruction to all agriculturists throughout the state. The experiment station has published 196 bulletins, of 20,000 in each edition, and 14 annual reports.

Members of the staff of the college are sent out whenever an outbreak of disease among either animals or plants is reported and, if familiar, it is extinguished; if unfamiliar, it is studied and a way found of preventing and curing it. In such an instance, that of the pear-sylla, a million dollars was saved to a single county, a few years ago.

This is work prescribed by the statutes and the charter of Cornell University. It is carried on mainly through the liberality, not of the state, but of Messrs. Cornell, Sage and other private contributors to the available funds of the university. Illinois, Iowa, Wisconsin and other states, similarly interested in agriculture, are providing handsomely for scientific work of this kind in their land-grant and state colleges. New York gains much, gives little.

Professor Robertson, Agricultural and Dairy Commissioner of the Dominion of Canada, after a three days' visit to Cornell, writes as follows:

"I do not know of another great university that is doing the same sort of work. Insti-

tutions of this kind generally confine their activities to the professional and scholastic classes, but here is one that is bringing its culture and its wealth of knowledge, based on careful research, to the help of the common people in their practical, every-day work."

R. H. THURSTON.

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*THE INTERNATIONAL GEODETIC ASSOCIATION.**

THE systematic reduction of the 52° parallel survey was published by the Central Bureau of the International Association under the title 'Lotabweichungen, Heft II.' The publication of the third part, which will contain the deflections along the northern geodetic lines of the 52° parallel survey, will be attempted this year.

Owing to the resignation of Dr. Schumann, who accepted the position of professor of geodesy, Fischer High School, the investigation of the curvatures of the meridians and parallels of the '*geoid*' could be but little advanced. Still, preparations for the computation of the triangulation through France, Spain and Algiers are in progress, and it is hoped that the final computations will be completed during the coming year.

Voluntary contributions of observations for variations of latitude during the year, from which to determine the motion of the earth's axis of rotation within its body, were received from only four observatories, namely, the observatories of Tokyo, Heidelberg, Leyden and Philadelphia. Unfortunately, the data thus furnished proved insufficient for an independent determination of the pole's motion. Utilizing these contributions, the results were compared with the motion of the pole as deduced from the series of special observations executed by the International Latitude Service, and it is gratifying to note that the comparisons proved the results to be satisfactory.

In this connection it remains to call attention to publication No. 6, of the Central Bureau, entitled 'Ergebnisse der Polhohenbestimungen in Berlin' during the years of 1889, 1890 and 1891, by Dr. Adolf Marcuse.

The work of the International Latitude Service made satisfactory progress during the year. Star-pairs were observed as follows:

Stations.	No. of Pairs Observed.	Observers.
1. Mizusawa	1,577	Kimura and Nakano.
2. Tschardjui	1,564	Medzwietsky.
3. Carloforte	3,386	Ciscato and Bianchi.
4. Gaithersburg	1,822	Davis.
5. Cincinnati	1,425	Porter.
6. Ukiah	2,014	Schlesinger.

The reduction of these observations was made immediately upon the receipt of the records by mail. In addition to these systematic computations, the Central Bureau also undertook the reduction of the *mean* declinations. The mean declinations were derived from Cohns' catalogue.

A list of the apparent declinations of the several stars thus observed, for the epoch of Greenwich culmination for the period November 2, 1902, to November 1, 1903, was prepared, and a copy sent to the observers for the purpose of enabling them to test and control their respective works by their own computations.

An abstract covering the most important results of this work is given by Dr. Albrecht in his article in No. 3808 of the *Astronomische Nachrichten*, entitled 'Resultate des internationalen Breitendienstes' for 1899.9–1902.0.

In this article Dr. Albrect calls attention to the fact that the motion of the earth's pole could no longer be satisfactorily represented by the expression:

$$\Delta\phi + v = x \cos\lambda + y \sin\lambda,$$

but that according to the suggestion of Professor Kimura in *Astrom. Nachr.*, No. 3783, an expression of the form

$$\Delta\phi + v = x \cos\lambda + y \sin\lambda + z$$

would have to be used instead. That is to say, the complete expression for the variation of latitude required an additional yearly term (z), wholly independent of the geographical longitude of the place of observation.

Determination of the Acceleration of Grav-

* Abstract of Professor Helmert's report on the activities of the Central Bureau of the International Geodetic Association during the year 1902, together with the proposed plan of work for 1903.

ity.—In accordance with the provisions of the plan of work for 1892, the measurements of gravity with the Italian pendulum, which on previous occasions had exhibited uncommon variations of length while swinging under diminished atmosphere pressure, were repeated, and it was found that the results for 1902 verified the results from the experiments of 1901.

The results from all these gravity experiments, which will be extended farther, if deemed necessary, in one or the other particular, will be published next year (1903).

Relative Gravity Determinations.—A comprehensive report on the relative determinations of gravity upon the Atlantic Ocean between Spain and South America has been published. The results found proved to be trustworthy, as also the newly determined relative results at the stations of Potsdam, Rio de Janeiro, Lisbon and Madrid, by means of the half-second pendulum. A new connection between the gravity stations at St. Petersburg and Potsdam is also contemplated. Moreover, Breteuil and other base-stations will also be connected by means of Stackraths' pendulum apparatus.

The commission also proposes to connect the Potsdam gravity station with their own pendulum apparatus and to determine the coefficients for air pressure and temperature. For the new Stackrath apparatus these coefficients were ascertained by adequate experiments at Rio de Janeiro. The constants of the four pendulums of Schumann (Strasburg), which have recently been materially remodeled, in order to improve them and render them less sensitive to variations of external conditions, will be determined.

Finally, it is proposed also to swing the pendulum at a series of stations in the high mountains of Central Asia, and to that end the trigonometric survey of India is bestowing particular care upon the determinations of the constants of temperature and air pressure for their own apparatus.

William Eimbeck.

THE BRITISH ANTARCTIC EXPEDITION.

The London *Times* publishes the following summary of the results of the National Antarctic Expedition contributed by a member of the scientific staff:

1. The discovery of extensive land at the east extremity of the great ice barrier.

2. The discovery that McMurdo Bay (?) is not a 'bay,' but a strait, and that Mounts Erebus and Terror form part of a comparatively small island.

3. The discovery of good winter quarters in a high latitude—viz., 77° 50′ S., 166° 42′ E.—with land close by suitable for the erection of the magnetic observations, etc. The lowest temperature experienced was 92° of frost Fahrenheit.

4. An immense amount of scientific work over 12 months in winter quarters, principally physical and biological.

5. Numerous and extensive sledge journeys in the spring and summer covering a good many thousand miles, of which the principal is Captain Scott's journey, upon which a latitude of 82° 17′ south was attained, and an immense tract of new land discovered and chartered as far as 83° 30′ south, with peaks and ranges of mountains as high as 14,000 feet.

6. The great continental inland ice reached westwards at a considerable distance from the coast and at an altitude of 9,000 feet.

7. A considerable amount of magnetic work at sea, also soundings, deep sea dredging, etc.

Captain Scott writes as follows:

We do not seem to have done much in any one particular direction, but I hope the sum total of our labors will not be displeasing to the societies. I must make a general apology for the sketchy nature of this note, which owing to the circumstances, has to be written in haste. When you receive it the matter will be decided, but as I write I am in considerable anxiety as to our prospects of getting out this season. It will be poor luck if we do not. We found one year's ice here last season; it broke away, and the spot remained open to the sea for at least six weeks; but we are now past the date at which it opened last season, and for this last fortnight little ice

has gone out, though in the past few days there have been renewed signs of a break up. The season is evidently very bad, and the weather is getting much colder and more blustering. Under these circumstances I am getting all the stores I can from the *Morning,* hoping to send her back to New Zealand in a week or so and to free ourselves at a later date. We shall be fully prepared for another winter, and I should not deplore it except as a waste of time. All our people remain as keen as possible. I think it would be difficult to imagine a happier or more comfortable community, considering how closely we are thrown together. If we get back this season it is my firm intention to do my best to raise money in the colonies for a third season, if the funds are not forthcoming from home. I think it would be difficult to praise Colbeck too highly for the manner in which he has followed our track, picked up our records, and found this ship; it has all worked out wonderfully well, but it must be appreciated what meagre information he had to work on, how intelligently he has followed the scent. The manner in which he and his ship's company lay themselves out to help us in every possible manner here is beyond all praise. We shall be quite comfortable, and I cannot think the harbor will remain closed for two seasons in succession.

THE BERMUDA BIOLOGICAL STATION.

THE time for making application to work at the temporary biological station at Bermuda has been extended from June 1 to June 15. Till June 1, application may be made to Professor C. L. Bristol, University Heights New York City. After that to Professor E. L. Mark, 109 Irving St., Cambridge, Mass.

One hundred dollars provides first-class passage from New York to Bermuda and return, six weeks' board and lodging—but not washing—at the Hotel Frascati, Flatts, Bermuda, ample facilities for collecting the animals and plants of the coral reefs, lagoons and shores, and a table in a temporary laboratory furnished with the ordinary glassware, reagents and apparatus provided in modern marine laboratories. The building secured for the laboratory is well constructed and new.

If applicants are able to send information as to the subject or subjects on which they desire to work, it will aid the management in making better provision for their accommodation. It may be possible in some cases to provide the use of a certain number of books and monographs, if applicants indicate those which they can not themselves procure.

It should be understood that the opportunities offered are for investigation and that no formal instruction will be given.

E. L. MARK,
C. L. BRISTOL.

THE LAKE LABORATORY OF THE OHIO STATE UNIVERSITY.

THE Lake Laboratory of the Ohio State University this summer will enter upon a new period of growth. The Cedar Point Pleasure Resort Company, which owns the long stretch of land bordering the east branch of Sandusky Bay has given a site for the new laboratory building in a most commanding and beautiful position where the laboratory will have at its very doors a magnificent stretch of Lake Erie beach, extended sand dunes, a native forest of cedars and other fine trees, an arm of the bay with good harbor for small boats and ready access to the larger bay and also an extensive swamp with a very varied vegetation.

The lease on this site runs for fifty years with privilege of renewal for a like term on the same conditions as to free rental, access of roads and freedom from buildings between laboratory and Lake front, and the Resort Company grants free transportation to students and workers at the laboratory on its steamers which, during the summer, ply between Sandusky and the resort two or three times per hour from early morning till late at night. The distance from the city being but two miles will make it possible to choose in the matter of living between the city boarding houses and the use of rooms in the labo-

ratory or tents, cottages or hotel accommodations available on the Point.

The new laboratory building which will accommodate at least one hundred students and investigators is already under construction under contract to be finished by June 15. This building includes four large laboratory rooms that will accommodate twenty to twenty-five students each in general work, two lecture rooms, four small laboratory rooms for special classes and rooms for about twenty research students or investigators, also private rooms for instructors, store room, dark rooms and other conveniences.

The location is about a half mile from the docks and buildings of the Pleasure Resort thus making it convenient to steamers and for mail, express, etc., but far enough away so that the work will not be interfered with by the patrons of the resort, nor will the virgin conditions of forest, beach and dunes be likely to suffer change for generations to come.

COMMITTEE ON THE PURITY OF CHEMICALS.

At the last annual meeting of the American Chemical Society, held in Washington in December, a committee, consisting of Professors Baskerville, Dennis, Hillebrand, Talbot and the president of the society as chairman, *ex officio,* was appointed to investigate the question of the purity of chemicals sold as pure for use as reagents. It is held by many analytical chemists that the quality of the reagents as furnished by dealers is far from satisfactory, and below the grade sold some years ago. It is also well known that the designations 'C. P.,' 'Chemically Pure' and 'Strictly Pure' as employed by certain dealers are practically meaningless. The committee wishes to discover the extent of the evil complained of in order to be able to suggest a remedy. Chemists who are interested in the matter and who are acquainted with facts bearing on the subject are invited to communicate their information to Professor H. P. Talbot, Massachusetts Institute of Technology, Boston.

TYPHOID FEVER AT PALO ALTO AND STANFORD UNIVERSITY.

The following are the facts in relation to the outbreak of typhoid fever in Palo Alto.

During the past winter, a dairy formerly of good repute, lying about four miles from Palo Alto, was leased to a Portuguese family. In this family, in March, a death occurred from typhoid fever. Two of the three houses stand on the bank of a brook which bounds the cattle yard. From this brook a wooden channel carries water to a large wooden trough within the yard. In this trough the cans and pails of the dairy were washed.

From the house, the excreta of the fever patient seem to have been thrown, Latin-fashion, on the ground, to be washed by the rains into the brook, and thence into the trough.

One of the milkmen supplying the town of Palo Alto bought milk from this Parreiro dairy. About April 6 cases of fever appeared in Palo Alto. The water supply of the town, as well as that of the university, from deep driven wells, was found above suspicion. This dairy was examined, bacilli were found in its milk, and on April 8 the milk route was closed. In this period, however, many people had taken the milk, and in the next three weeks there were upwards of 150 cases in the town, 80 of them being students of Stanford University.

On the university campus, a mile away, about 850 of the 1,480 students of the university live. Two fraternity houses on the campus were served with milk from Parreiro's. In one of these houses fourteen out of twenty persons were attacked. In the other four out of twenty. In the university dormitories, and in the remaining fraternities there have been a few cases, persons who had eaten at a Palo Alto restaurant or had been guests at some infected house.

About 110 cases have developed among the students of the university, and there have been four deaths, all in Palo Alto. The source of infection was promptly detected. The period of incubation, about three weeks, is now past; every care has been taken to pre-

vent secondary infection, and thus far there have been no cases from such infection.

There is no epidemic, no panic, and no 'infected' district. The chief lesson lies in the need of closer inspection of the habits and methods of dairymen and gardeners who come from the south of Europe.

SCIENTIFIC NOTES AND NEWS.

The following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society: Dr. William Maddock Bayliss, Professor Thomas William Bridge, Dr. Sydney Monckton Copeman, Mr. Horace Darwin, Mr. William Philip Hiern, Mr. Henry Reginald Arnulph Mallock, Professor David Orme Masson, Mr. Arthur George Perkin, Professor Ernest Rutherford, Professor Ralph Allen Sampson, Mr. John Edward Stead, Mr. Aubrey Strahan, Professor Johnson Symington, Professor John S. Townsend and Mr. Alfred North Whitehead.

M. de Forcrand has been elected a corresponding member of the Paris Academy of Sciences in the section of chemistry, in the room of the late M. Reboul.

The contest of the election for the post of secretary to the Zoological Society of London has ended in an undoubted victory for the supporters of Dr. P. Chalmers Mitchell, who have occasionally been spoken of as the 'reform party.' The poll was unprecedentedly large and the numbers were: Mitchell, 530; Sclater, 336. Whatever views one may hold as to the respective merits of the candidates, it is at least satisfactory that the question has been settled in so definite a manner, as this will conduce to much greater stability in the future conduct of the society's affairs, and the storms that have raged over the contest are likely to calm down all the sooner.

Professor L. M. Underwood, of Columbia University, is still in Jamaica. He will visit Dominica and other islands of the Windward group, after which he will go to Europe to study ferns in English and continental botanical gardens and museums.

Dr. J. Playfair McMurrich, professor of anatomy at the University of Michigan, has accepted a commission from the Royal Academy of Prussia and the government of Holland to examine and identify certain species of animal life.

Dr. Arthur Hollick, assistant curator of the New York Botanical Garden, has received leave of absence for four months, with the object of investigating the fossil plants of Alaska in order to determine certain geological horizons through the aid of paleobotany.

Harlan I. Smith, of the American Museum of Natural History, has gone to North Yakima, Washington, where he has begun work on the archeology of the Columbia Valley in continuance of his general archeological reconnoissance of the northwest.

Forest B. H. Brown, a member of the senior class in the University of Michigan, has been appointed to conduct an investigation under the direction of the Michigan state geological survey of the plant societies of Monroe and Washtenaw counties, Michigan, with reference to their historical succession and their relation to water supply.

Dr. George S. Fullerton, professor of philosophy in the University of Pennsylvania, has gone to Germany and will spend the summer at Munich.

We learn from *The British Medical Journal* that Mr. A. G. R. Foulerton has resigned the position of director of the Cancer Research Laboratories, a position which he has held for the last three years. The weekly board of the hospital has decided on the appointment of a director who will be required to devote the whole of his time to the work of the Cancer Research Laboratories. Mr. Foulerton will continue his service to the hospital as director of the Clinical and Bacteriological Laboratories.

Mr. Andrew Carnegie presided at the annual dinner of the British Iron and Steel Institute on May 8. Addresses were made by Mr. Balfour, the Duke of Devonshire, Sir Henry Campbell Bannerman and others.

The following have been nominated as vice-presidents of the Royal Institution, London,

for the ensuing year: Sir Benjamin Baker, Sir Frederick Bramwell, Lord Halsbury, Dr. W. C. Hood, Lord Lister, Mr. George Matthey, Sir James Crichton Browne (treasurer) and Sir William Crookes (honorary secretary).

THE Association of American Physicians has elected the following officers: *President,* Dr. William T. Councilman, Boston; *vice-president,* Dr. Edward Trudeau, Saranac Lake, N. Y.; *recorder,* Dr. Solomon Solis-Cohen, Philadelphia; *secretary,* Dr. Henry Hun, Albany; *councilors,* Drs. Victor C. Vaughan, Ann Arbor, Mich., and George M. Kober, Washington, D. C.

THE Carnegie Institution has made a grant of $500 for a research assistant to Dr. M. Gomberg, junior professor of chemistry in the University of Michigan. Mr. Lee H. Cone, who has been doing graduate work in the university since September, 1902, has been appointed to that position for the year 1903–4.

The British Medical Journal states that Professor Zakharoff of the faculty of medicine of the University of Warsaw, and director of the Veterinary School of that city, is likely to fall a victim to his zeal for scientific research. In making a necropsy of the brain of a dog which had died of rabies, he inflicted a slight cut on one of his fingers, to which he paid no attention. About a fortnight later symptoms of hydrophobia appeared, and he was taken to the Pasteur Institute, which is under the direction of Professor Palmyski. There is said, however, to be no hope of Professor Zakharoff's recovery.

PRESIDENT PRITCHETT, of the Massachusetts Institute of Technology, is to give the commencement address at the University of Virginia on June 15.

PROFESSOR WM. T. SEDGWICK, of the Massachusetts Institute of Technology, recently gave the annual address before the alumni association of the medical department of the University of Buffalo, his subject being 'Protection of the Public Health by the Filtration of Municipal Water Supplies.'

THE Wild Flower Preservation Society of America held a meeting under the auspices of the Olivia and Caroline Phelps Stokes Fund for the Protection of Native Plants in the Museum Building of the New York Botanical Garden on May 16, when Mr. Charles Louis Pollard delivered an illustrated lecture on 'Vanishing Wild Flowers.'

PROFESSOR G. ROMITI, of Pisa, celebrated on March 5, the twenty-fifth year of his incumbency of the chair of anatomy at Siena and Pisa. He was presented with a souvenir volume of the 'Archivio Italiano di Anatomia ed Embriologia' and a gold medal.

THE hundredth anniversary of the birth of Liebig was celebrated on May 12 by the University of Giessen and the Technical School of Darmstadt.

THE London *Times* states that a representative committee has been formed for the purpose of raising a memorial to the late Sir Henry Bessemer. The extraordinary industrial development of the world in recent years is largely due to the metallurgical process which bears the name of Bessemer, and it has long been felt that his life's work should be suitably commemorated in the center of the British empire. The objects of the memorial are as follows: (1) The erection (and, if necessary, the endowment) of metallurgical teaching and research work in connection with the University of London, equipped for the testing of ores and metallurgical products by modern methods and for the investigation of new methods and processes. (2) The foundation of international scholarships for post-graduate courses in practical work in connection with proposals now under the consideration of the board of education. The committee includes leading representatives of the metallurgical, engineering and mining industries and professions, and of education authorities. A meeting to inaugurate the fund will be held at the Mansion-house on June 29 next, particulars of which will be published later.

MR. ABRAHAM FOLLETT OSLER, known for his work in meteorology, died at Birmingham on April 26, at the age of ninety-five years. He had been a member of the Royal Society since 1855.

We regret also to record the deaths of Dr. C. H. Dufour, professor of astronomy in the University of Lausanne; of M. René Mammert, professor of chemistry at the University of Freiburg in Switzerland; of Dr. Clemence von Kahlden, professor of pathological anatomy at Freiburg i. B.; and of Dr. Heinrich Hartel, formerly professor of geodesy at Vienna.

The American Institute of Electrical Engineers held its annual meeting in New York City on May 19.

The fifteenth international medical congress will be held at Lisbon in 1906 with Professor Alfredo da Costa as president.

The government has introduced a bill in the Swedish *Riksdag* granting about $50,000 for the equipment of a vessel to be sent to the relief of the Nordenskjold Antarctic expedition.

Oswald Wiegel, of Leipzig, will sell at auction on June 11–13 the library of the late Dr. Julius Platzmann, which contains some fourteen hundred works on American languages, especially on the languages of South America.

During the last field season Mr. Whitman Cross, of the United States Geological Survey, visited the Hawaiian Islands for the purpose of observing the results of volcanic activity at Kilauea. Critical comparisons were made between the modern volcanic rocks of these islands and the areas of old volcanic rocks occurring in the Rocky Mountain country. The larger islands of the group were all visited, advantage being taken of this opportunity to gather data for use in planning future work in Hawaii by the Geological Survey.

A press despatch from Washington, dated May 13, says: "The executive committee of the Carnegie Institution reports that the entire sum of $200,000 allotted to grants for original research has been distributed, and that of the $40,000 set aside for publications to be made this year $20,000 has been assigned to special publications, leaving $20,000 still at the disposal of the executive committee. No more grants for researches will be made until after the next meeting of the board of trustees, which will be held in December. At the meeting of the executive committee today the question of giving more publicity to the grants of the institution was not taken up. The policy hitherto has been to permit the receivers of grants to make them public, but for the officials of the institutions to refrain from giving out names of the fortunate scientists who receive these grants. It is probable that this policy will be continued."

A chapter of the university scientific society of the Sigma Xi has recently been established at the University of Chicago. Chapters of this society are now maintained at the following universities: Cornell, V. A. Moore, president; Union, O. H. Landreth, president; Kansas, F. H. Snow, president; Rensselaer, W. P. Mason, president; Yale, J. P. Tracy, president; Brown, W. W. Bailey, president; Nebraska, L. Bruner, president; Minnesota, J. J. Flather, president; Iowa, T. H. McBride, president; Ohio, W. R. Lazenby, president; Pennsylvania, E. F. Smith, president; Stanford, V. L. Kellogg, president; California, C. L. Cory, president; Columbia, J. F. Kemp, president; Chicago, H. H. Donaldson, president.

The International Mathematical Congress will meet at Heidelberg in August of next year.

It is expected that the International Electrical Congress will be held at St. Louis, during the week beginning September 12, 1904. It will thus immediately precede the International Congress of Arts and Sciences.

A meeting of the committee of the Central International Bureau for the Prevention of Consumption was held in Paris on May 4 and 5 to make preliminary arrangements for the next international congress, which is to take place at Paris in October, 1904.

A cablegram from Paris to the daily papers states that the airship constructed for the Lebaudy Brothers made a highly successful trip on May 8 under Pilot Juchmes and Engineer Rey. The start was made at 9 A.M. from St. Martin during a light rain and with a brisk wind blowing. The dirigible airship

passed over a number of suburban towns. At Mantes the airship made a circle around the cathedral spire and on leaving that town went diagonally against the wind. Over Limay, Mantes and Rosny the airship was put through a series of evolutions and answered her helm and manoeuvred to the perfect satisfaction of all interested in her. She then returned to her point of departure, where she descended without accident. The distance covered was 37 kilometers in one hour and thirty-six minutes, against Santos-Dumont's record for the Deutsch prize of 11½ kilometers in thirty minutes.

At the twenty-fifth annual general meeting of the Institute of Chemistry, Professor J. M. Thomson, F.R.S., the retiring president, delivered an address in which he sketched the history and work of the institute since its foundation. He said that the real origin of the institute was in a suggestion put forward in 1872 by the late Sir Edward Frankland, at a dinner given to Professor Cannizzaro on his appointment as Faraday lecturer. Later, in 1876, he proposed to the council of the Chemical Society that a class of fellows, to be styled licentiates (or some analogous title), should be created for the purpose of distinguishing between competent professional chemists and those who professed an interest in chemistry as a science, and not as a means to earning a livelihood. The idea was not adopted, but it was decided to found a new society, and the Institute of Chemistry was formally incorporated under the Companies Act on October 2, 1877. Among those active in founding the institute were Mr. Carteighe, Professor Hartley, the late Mr. Frederick Manning, Mr. Charles Tookey and the late Dr. Alder Wright. Professor Thomson himself was also a keen worker for the institute in its earliest history. He proceeded to relate its progress under the successive presidents: Sir Edward Frankland, Sir Frederick Abel, Dr. William Odling, Dr. James Bell, Professor W. A. Tilden, Dr. W. J. Russell and Dr. Thomas Stevenson. He dealt with the regulations as to training and examination of candidates for the associateship of the institute, showing how the standard of the requirements for membership had been steadily raised, and he commented on the consequent increasing recognition of the qualifications 'A.I.C.' and 'F.I.C.' by government and municipal authorities and by the leaders of industry throughout the kingdom. The annual report of the institute drew attention to the increase in the number of members, in spite of the fact that there had been heavy losses through death. Attention was also called to the increase in the number of candidates for examination, notwithstanding that within the last few years the standard of admission had been considerably raised. The adoption of the report was seconded by Dr. Thomas Stevenson, and carried. The newly-elected president, Mr. Thomas Howard, then took the chair.

We learn from the London *Times* that a recent cablegram from Captain Colbeck brings the information that, when he discovered the position of the winter quarters of the expedition in McMurdo Bay, the ice prevented him from bringing the *Morning* nearer than eight miles to the *Discovery*. The transshipment of coals and provisions had, therefore, to be done by means of sledges dragged over that distance. Nor was this the only difficulty. On completion of the transshipment the distance had been reduced to five miles, showing that, in addition to the hard work of transshipment, there must have been much trouble with the ship in moving her about at the edge of the ice as it broke away. The failure of the provisions on board the *Discovery*, the particulars of which have not yet been received, made it necessary for the *Morning* to transfer a much larger quantity of provisions than was intended, and this will entail large additional expense. It is now clear that it would have been quite impossible for the *Discovery* to return this year. But she is only provisioned until next January, so that the despatch of the *Morning* for her relief a second time is an absolute necessity in order to avoid a catastrophe. For the additional expense a sum of £12,000 is urgently needed, £6,000 this year, and the rest next year.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. Henry Denhart, of Washington, Ill., who has in the last five years given $35,000 to Carthage College, announces a further gift of $145,000 on certain conditions. He offers $100,000 for the endowment fund providing that the same amount be raised in the college territory, half of the expense of any new buildings erected up to $20,000, and $25,000 cash.

Plans have been completed for the new engineering building of the University of Pennsylvania, which will be located opposite Dental Hall, and will be completed in September, 1904, at a total cost of $500,000. The building is to be 300 feet long and 175 feet deep, with an exterior of dark brick and sandstone trimmings.

The chair of electrotechnics at University College, Liverpool, has been endowed with £10,000 by Mr. Jardine.

University Inn, at State College, Pa., was destroyed by fire on May 9, causing a loss of about $35,000; insurance, $13,000. The inn was occupied by thirty-five students of the State College, and seven professors and their families.

A meeting of educators representing principally the colleges of the middle west met at Chicago on May 8 and 9 to discuss the college and its relation to the professional schools. A national college association was formed which will hold annual conferences.

The Yale University Corporation at the May meeting approved the recommendations of the academical professors to extend the elective system into the freshman year by allowing each freshman to choose five out of eight courses of study and to allow the substitution of advanced work in mathematics or modern languages in place of Greek for admission to college. The new requirements for admission, which will go into effect in 1904, leave English, ancient history and Latin unchanged, but will allow Greek to be wholly or in part superseded by an additional amount of mathematics or by a thorough knowledge of either French or German. In the freshman year the eight courses open to the class, five of which must be elected, are Greek, Latin, French, German, English, mathematics, chemistry and history. It is required that three of the five courses elected must be in continuation of the five studies—Greek, Latin, English, mathematics, or a modern language —already pursued in the preparatory school.

The Rev. Edwin H. Hughes, of Malden, Mass., has been elected president of De Pauw University, at Greencastle, Ind.

Professor William H. Brewer has resigned the professorship of agriculture at Yale University and has been appointed professor emeritus.

Mr. Gifford Pinchot, chief of the Bureau of Forestry, has been elected to a professorship in the forest school of Yale University. He will continue his work and his residence in Washington, but by special arrangement will lecture at Yale. Assistant Professor J. W. Toumey has been advanced to a full professorship in the Forest School.

At Cornell University Professor T. F. Hunt, dean of the Agricultural College, of the Ohio State University, has been appointed professor of agronomy and Dr. B. F. Kingsbury has been appointed assistant professor of embryology. Dr. Kingsbury was formerly instructor and has spent the last two years in study at Freiburg.

At Harvard University Messrs. A. F. Blakeslee and J. J. Wolfe have been appointed Austin teaching fellows in botany.

Philip Bouvier Hawk, M.S., for the past two years assistant in physiological chemistry at Columbia University, has resigned his position to accept that of demonstrator of physiological chemistry at the University of Pennsylvania.

Mr. Howard S. Reed, assistant in plant physiology in the University of Michigan, has been appointed instructor in botany at the University of Missouri.

M. Charrin has been apointed to a newly-established chair of general pathology in the Collège de France; Dr. Flügge, of Breslau, has been appointed professor of hygiene in the University of Vienna.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 29, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

HENRY BARKER HILL.

HENRY BARKER HILL, professor of chemistry and director of the Chemical Laboratory of Harvard College, died on April 6, 1903, in the fifty-fourth year of his age, after a brief but painful illness. His death makes an irreparable gap in the ranks of American scientific men.

Professor Hill's life was a quiet one—the life of an investigator in a field of scientific rather than of public interest. His delicate health for years and his retiring disposition prevented many of his colleagues from knowing him well; hence his true worth has perhaps not been fully appreciated by those outside the circle of his intimate friends.

The Reverend Thomas Hill, his father, was at one time president of Antioch College, and later, from 1862 to 1868, president of Harvard University. In 1845 Thomas Hill married Miss Anne Foster Bellows, and on April 27, 1849, Henry Barker Hill was born. Having spent his later school days in Cambridge, he entered Harvard College in 1865 at the age of sixteen years. Here his unusual versatility was soon recognized by his early companions, who felt that with so many possibilities the choice of a profession must be difficult. His mathematical ability was rare; he possessed a keen and sympathetic taste for music, and his literary and philological in-

stincts were strong. When the decision was made, however, there was no swerving or faltering in the path. After graduation in 1869, he went to Berlin, where he studied chemistry for a year with A. W. Hofmann. On returning to America, he was made assistant in chemistry in Harvard University, a post which he held for four years. At the age of twenty-five he was promoted to an assistant professorship, and ten years afterwards became full professor. The always increasing administrative duties of the growing department of chemistry were divided on the death of Professor Josiah Parsons Cooke in 1894, and Professor Hill was given the responsibility of the management of the laboratory as director, while Professor Charles Loring Jackson was made chairman of the department. During the nine years of his directorship, Professor Hill, with the utmost ingenuity, remodeled and enlarged an old and unsuitable building with such success as to provide available accommodation for over seven hundred men, and to increase immensely the efficiency of the institution. Administrative work of this kind was undertaken with the conscious sacrifice of some of his dearly cherished scientific ideals, but no murmur of complaint escaped him. The long service of thirty-three years to Harvard University was unremitting; for he never claimed the occasional holiday-year which was his due.

On September 2, 1871, he was married to Miss Ellen Grace Shepard, who with their son, Edward Burlingame Hill, survives him. In recent years their summers have been spent in Dublin, New Hampshire, and bicycle rides thence to Cambridge on laboratory business were not unusual occurrences during the summer months.

The National Academy of Sciences elected Professor Hill to membership as long ago as 1883, and he was also a fellow of the American Academy of Arts and Sciences and a member of the Washington Academy and of the American and German Chemical Societies.

Professor Hill's original scientific work was marked by the quality which preeminently characterized his whole life—absolute sincerity. At the outset, great enthusiasm enabled him soon to overcome the handicap of his somewhat inadequate training, and even his first paper on methyluric acid was an unusually thorough and convincing piece of work. Soon afterwards his fortunate discovery of the rare substance furfurol among the products of the dry distillation of wood, enabled him to begin its investigation; and for twenty years his best thought was given to the derivatives of this substance, especially to pyromucic, mucobromic and mucochloric acids. This series of investigations constitutes a remarkably complete and systematic whole, raising a large group of substances from a position of oblivion to one of commanding importance. Later his discovery of nitromalonic aldehyde led him to a number of interesting syntheses of the benzol ring; and last winter he was engaged in the study of derivatives of pyrazol, another ring-structure.

An acute sense of the responsibility of publication was always in his mind; accordingly his words were carefully weighed, and unusually free from misstatements. Work done by students was always repeated with his own hands before publication—instead of being tested only here and there, after the manner of most chemists. His remarkable lectures on organic chemistry were noticeable for the same admirable completeness; they presented a finely balanced and comprehensive view of the subject. In these lectures he occasionally expressed theoretical views of his own

which never appeared in print. Many of these views have since been generally adopted at the later independent suggestion of others less diffident about publication. An example in point is his opinion concerning the structure of diazo bodies, first conceived by him over twenty years ago, and now conceded to be the most probable hypothesis.

Hill's original work and his lectures were equally conspicuous for thorough knowledge, convincing logic and perfect sincerity. Until the end his highly cultivated and widely varied tastes continued to be sources of refreshment and pleasure to him, while to those of his colleagues who came closest he revealed also keen and appreciative sympathy, self-forgetting generosity, a stanch and devoted friendship, undaunted courage, and above all, single-heartedness in the search for truth.

T. W. R.

THE STATUS OF PUBLIC MUSEUMS IN THE UNITED STATES.

I. THE AUSPICES OF OUR MUSEUMS.

No general discussion of the status of our museums has been attempted, although G. Brown Goode (see 'Annual Report of Smithsonian Institution,' 1897, Vol. II., U. S. National Museum) has presented many phases of the subject in a masterly manner in his papers upon 'The Genesis of the United States National Museum,' 'The Origin of the National Scientific and Educational Institutions of the United States,' 'The Beginnings of American Science,' etc. He also instituted some comparisons between our museums and those of Europe, and in his report upon the condition and progress of the U. S. National Museum, 1892–93, he shows that while for 24 years the South Kensington Museum had spent an annual average of about $47,000 in the purchase of specimens, our National Museum had never spent more than $8,500 annually for this purpose.

It is gratifying to observe that while our National Museum has been enabled to spend annually somewhat more for specimens than during the period referred to by Goode, yet in 1901 the American Museum of Natural History expended more than twice as much as the National Museum for this purpose.

The whole question of museum status has become an important one, as we are in all probability upon the eve of a museum movement which may prove comparable with the great increase in efficiency and number of our public and school libraries, which during the five years from 1895 to 1900 have increased from 4,026 to 5,383, and the number of volumes from 33,051,872 to 44,591,851, or almost 35 per cent.

No corresponding increase has taken place in the number of our public museums or in the magnitude of their collections; and, indeed, the subject has attracted so little public interest that no published lists of our museums are at present available, although a very valuable list of the natural history museums of the United States and Canada and an account of their collections are being prepared under the direction of Professor Frederick J. H. Merrill, of the New York State Museum, and will soon be published.

Professor Merrill has been so kind as to allow me to inspect the proofsheets of this interesting work, and I am also indebted to the Smithsonian Institution for a partial list of the museums of the United States. It appears that within the United States there are at least 252 institutions which contain collections of objects of natural history. Of the total number, 176 or 70 per cent. are school, college or university museums; 31 are the museums of learned

societies; 29 are under national or state control, such as the museums of the various geological surveys, agricultural and mining bureaus, etc. Sixteen of our museums are not under the control of colleges, learned societies or national or state governments, but either are maintained by private endowment derived from public-spirited citizens, are supported by municipalities, or are under the control of boards of trustees, who administer funds derived both from cities and from private subscription.

It is noteworthy that, although the number of such institutions is as yet small, among them we find some of the greatest and most useful of our museums, such as the American Museum of Natural History, the Field Columbian Museum, the Carnegie Museum at Pittsburgh, etc.

It is both sad and interesting to observe that no society composed primarily of learned men has succeeded in maintaining a thoroughly successful museum, yet forty-five years ago the leading museums of our country were controlled by such societies. It is possible that the government of these societies may have been too democratic to insure that permanency of policy and maintenance of a strong executive which appear to be necessary to insure the success of American institutions of learning.

However, these societies have not advanced in material resources at a rate comparable with that of the country itself, and in consequence are relatively poorer to-day than they were many years ago. Their general lack of success is the more remarkable from the fact that most of them have existed in our wealthiest and most progressive cities, and that while other institutions of learning have received bountiful support from both private and public sources,* the museums of learned societies have been relatively neglected. In other words, they have generally failed to interest men of wealth who are desirous of devoting a portion of their resources to the advancement of public education.

Experts upon scientific subjects are not usually adepts in matters of finance, and the successful management of a great museum appears to demand that its financial resources and expenditures be under the control of a board of trustees composed of representative men of affairs, while the scientific policies of the institution might well be directed by men of science.

Such, in general, is the scheme of management of some of our best museums, and it would appear that our learned societies must surrender the control of financial matters into the hands of experts in finance before they can hope to achieve their due measure of success in museum management. It is much to be regretted that many of the collections which have furnished the basis for classic memoirs of science, and some of the most valuable scientific libraries in our country, are stored in buildings which are not fire-proof and are inadequate in many ways for the proper care and maintenance of the treasures which they contain.

Turning to the subject of museums under the control of colleges and universities: 176 such institutions are known to maintain collections in the natural sciences, while 44 more small colleges are believed to contain collections. It is safe to say that fully two thirds of these college museums are, as Goode aptly states, 'mere storehouses for the materials of which museums are made.' Our universities, both under private endowments and under state control, are developing good museums, but it

* In 1850 the funds of Yale University amounted to about $300,000. In 1902 they were over $6,800,000. During the same period the funds of Harvard have increased from a little over $600,000 to more than $14,000,000.

is worthy of note that the most successful of these owe more of their prosperity to the generous interest and financial support of public-spirited individuals than to the college itself.

A good example of this condition is seen in the zoological museum of our oldest university, which, distinguished above all others for its publications of research and for having been the cradle of most of our leading naturalists, has been mainly dependent for many years upon the generous bounty of a single individual. Other examples might be cited, but the above will suffice to show that even our greatest and richest universities have not been able to maintain museums worthy of their aims, unless aided by private subscriptions for the purpose. The financial resources of our universities have been taxed to the utmost in the erection of buildings and employment of leading scholars upon their faculties, and few of them have been able to devote a due measure of support to museums.

Moreover, our universities have often failed to recognize the benefit which the museum may confer upon the institution as a whole as a center for productive scholarship and publication of research.

Unfortunately, at present, museum curators are too often narrow specialists who display little interest in subjects other than those which demand their immediate attention, but the fact remains that the curator enjoys a unique opportunity in that he gains much of his knowledge direct from nature and that in this his opportunities for research and exploration are unrivaled. The organization of graduate schools in our universities is beginning to demand the appointment of professors who shall be productive scholars and leaders of research, and who shall instil into the graduate students that thirst for knowledge and desire for its advancement which inspires the university students of Germany. The curators of university museums should be men of this stamp.

Too often our college museums are vast storehouses of practically unstudied materials under the charge of men who are already overworked in the prosecution of their duties as teachers of elementary facts, or worse still, under the control of specialists who rarely or never may lecture to the student body, and whose store of valuable knowledge is wasted in seclusion. The university museum should be the center for the intellectual life of the graduate student in the natural sciences. The curators should be his teachers, and the resources of the museum should be constantly expanded to meet his needs, and to encourage research which may lead to the discovery of new laws of science.

It is remarkable that, although large sums have been given within recent years for the construction of buildings and for the purchase of collections in our museums, relatively little has been devoted to the endowment of publications of research.

Our university museums must remain ineffective as centers for the advancement of science until this defect has been overcome.

It appears that museums under purely political or governmental auspices have in our country rarely attained to that success which one might reasonably have expected them to have achieved.

Without in the least reflecting upon the character or abilities of the corps of eminent men of science whose names are inseparably connected with that of our National Museum, and who in the face of limited means and meager opportunities have devoted their lives to its service, it may not be too much to say that this institution should be granted a greater measure of independence, its curators should have

more freedom to devote their energies to the advancement of science, and the museum must receive more effectual rather than greater financial support before it can hope to attain to that exalted position among the world's museums which should be occupied by the National Museum of the United States.

On the whole, it appears that our most successful museums are those in which the financial control is vested in boards of trustees composed of representative, public-spirited men of affairs, who serve without salary and who determine the expenditure of funds derived from both public and private sources. Such boards of trustees should be and usually are dependent upon the advice of scientific men for suggestions concerning the scope, management and educational policy of the museum.

The responsibility incident to the administration of public funds maintains the stability and efficiency of the board, and enables it to secure the services of men of culture, energy and influence, whose connection with the museum becomes an important factor in maintaining public interest and respect for the institution.

II. SCOPE, DISTRIBUTION AND RESOURCES.

From a study of Merrill's 'List of the Natural History Museums of the United States,' *The American Art Annual*, 1900, and other sources of information, it appears that there are within the United States at least 233 museums of natural history, 13 of science and the fine arts, 6 of science and industrial arts, 34 of fine arts, 11 of industrial arts, 20 of history, and 26 which combine art, history, archeology and ethnology in varying proportions. There are thus at least 343 collections in the fields of art, science and history open to the public of the United States.

It is evident that our country is already rich in incipient museums, for while many of the collections recorded above are mere 'materials out of which museums may be made,' there is reason to expect that a large proportion of them will ultimately develop into creditable museums.

The fact that there appear to be but 17 museums devoted to the industrial arts in the United States is remarkable when we consider the enormous progress which our country has made in this direction. This may possibly be taken as an indication of the general lack of interest in museums which prevailed until within recent years in our country, and this explanation appears more probable when we consider that among our most valuable industrial collections are those in the Patent Office building, which were accumulated not primarily for the purpose of establishing a museum, and that such exhibitions are either insignificant or altogether wanting in our great industrial cities. With the exception of Philadelphia, our industrial cities have not yet awakened to an appreciation of the valuable educational influence which may accrue through the exhibition of carefully selected and clearly labeled models of machinery and apparatus used in the arts and trades, and displays of products in various stages of manufacture.

Certainly the remarkable advance which Germany has achieved in manufacture and in the industrial arts has received substantial aid from her great industrial museums, where these processes may be studied in detail. Our technical schools and colleges should devote more attention to the establishment of well-planned museums, wherein the processes of the arts and the history of inventions may be exhibited.

Although our museums are most deficient in industrial exhibits, they are but little better in their historical dis-

plays. Only 43 museums known to the writer contain historical exhibits, and 84 per cent. of these are in the oldest states. Massachusetts leads with 12 such museums. Pennsylvania has 10, Virginia 4, Washington, D. C., and New York 3 each, while California and Illinois have 2 each. Maine, Maryland, New Jersey, New Mexico, Ohio, Rhode Island and Utah have each one such museum. Nearly all of these museums are under the control of historical societies, most of which receive little or no aid from public grants and, in common with other learned societies in our country, are financially poor and becoming relatively poorer as the country develops. A museum of history maintained at least partially by public funds should be established in each of our leading cities.

Although remarkable progress has been made in the establishment of museums of art in our country within the past ten years, these institutions still exist in surprisingly small numbers even in some of our richest states. Massachusetts has 14, New York and Pennsylvania 12 each, Washington, D. C., 7, California 3, Colorado, Connecticut, Illinois, Maryland, Rhode Island and Virginia have 2 each, while Georgia, Michigan, Missouri, New Mexico, Ohio, Oregon, Utah and Wisconsin each have 1. In addition to these, however, there are 19 general museums which are devoted to both science and art. Eighty per cent. of our art museums are in the states on the Atlantic seaboard. The majority of these institutions are art galleries rather than museums of art. Nowhere is the labeling more imperfect or the arrangement of the exhibits more illogical, from the educational standpoint, than in most of our art museums. Almost no effort is made to give a comprehensive view of the development of art, and the pictures are arranged to produce what is known as an 'artistic effect' rather than to show the sequence of the various schools or the causes of their rise and decline. We also learn but little of the life histories of the artists, their aims or achievements, and the display is designed to appeal more to the eye than to the mind. It is not the purpose of this article to criticise, but to indicate what might be done in the future. No department of museum activity can exert a more immediately refining influence upon the people or lead more surely and rapidly to a higher development of public appreciation of the beautiful, than that of art. The contrast between the architecture in our American cities and that of those in Europe is sufficient warrant for the conclusion that although great improvements have been made within the past few years, public appreciation is still crude and uneducated in matters of art.

Our oldest, most numerous and, in general, richest museums are those devoted to natural history. These are more uniformly distributed over the country than are museums of other sorts, only 46 per cent. of them being found in the region comprised in the original thirteen states. New York leads with at least 31 such museums, then follow Pennsylvania with 19, Massachusetts 17, Illinois 15, Ohio 14, and California with 10. Not only are the natural history museums of New York and Pennsylvania more numerous than those of Massachusetts, but the annual income of a single natural history museum in New York is much greater than the combined incomes of all such museums in Massachusetts, and the richest museum in Massachusetts has not one third the annual income of the Field Columbian Museum of Chicago.

Although now small and poorly supported financially, a generation ago the natural history museums of Massachusetts

were the most creditable in our country, and while they are still distinguished as having been the fields of labor of some of our greatest naturalists and as having produced research work of high and lasting value to science, yet are they doomed to sink into insignificance in comparison with those of New York, Illinois, Pennsylvania and California unless that public spirit which has ever distinguished Massachusetts be immediately aroused in their behalf.

NUMBER OF MUSEUMS IN EACH STATE.

Name of State.	Natural History.	Art, History, Industries, Etc.	Total.
New York	31	13	44
Pennsylvania	19	18	37
Massachusetts	17	20	37
Illinois	15	3	18
California	10	5	15
Ohio	14	1	15
District of Columbia	6	8	14
Virginia	4	5	9
Colorado	6	2	8
Kansas	8	0	8
Maryland	5	3	8
Wisconsin	7	1	8
Connecticut	5	2	7
Iowa	7	0	7
Missouri	6	1	7
Rhode Island	4	3	7
Indiana, Minnesota, Tennessee	5	0	5
Georgia, Maine, Michigan	4	1	5
Kentucky, South Carolina, Vermont, Washington	4	0	4
New Jersey	3	1	4
Alabama, Mississippi, Nebraska, New Hampshire, South Dakota, Texas	3	0	3
Oregon	2	1	3
Florida, Hawaii, Louisiana, North Carolina, North Dakota, Utah	2	0	2
New Mexico	1	1	2
Arizona, Arkansas, Delaware, Idaho, Indian Territory, Montana, Oklahoma, West Virginia, Wyoming	1	0	1

Within recent years Boston has acquired what is probably the most extensive and well-planned system of public parks in our country, but it must be stated, to her discredit, that she gives nothing to the support of her museums, all of which are struggling against undeserved poverty. In this respect she is more conservative than New York, Philadelphia or Chicago; and even small cities of Massachusetts display a more enlightened policy than Boston.*

The accompanying table gives the geographical distribution of our museums.

RESOURCES AND EXPENDITURE OF OUR MUSEUMS.

No general consideration of museum economy in the United States has hitherto been attempted. Believing that some interesting results might be derived from such a study, an examination was made of the latest treasurers' reports of sixteen of our leading museums, such as the National Museum, American Museum of Natural History, Metropolitan Museum of Art, Field Columbian Museum, Pennsylvania Museum and School of Industrial Art, Free Museum of Science and Art of the University of Pennsylvania, The Museum and Library of the Art Institute of Chicago, Carnegie Museum of Natural History, Museum of Comparative Zoology at Harvard College, Museum of the Boston Society of Natural History, Cincinnati Museum Association, Peabody Museum of Archeology in Cambridge, Detroit Art Museum, and three other institutions which are under political auspices and whose employees are controlled by civil service rules. The total annual income of these museums amounted to $1,418,144, of which $723,583 was derived from public grants, while $694,561 was obtained from private sources consisting of gifts, subscriptions, interest on endowment and admission fees. This amount does not include balances on hand at the beginning of the year or the proceeds of sales of speci-

* In 1901–02 the city of Springfield, Massachusetts, appropriated $29,945 for the maintenance of its museums and library.

mens or catalogues, but represents the voluntary contribution of individuals to the direct support of the museum.

These museums expended $725,116 for salaries and wages, from which we see that the public support which they received was not quite sufficient to meet this item alone, the entire expense for maintenance, purchase of specimens, cost of expeditions, libraries and publications being, so to speak, borne by voluntary subscription of private individuals.

It is possible to discover the amounts paid for specimens in the case of thirteen of these museums; the total sum being $80,828, or less than twice the sum annually expended by the Kensington Museum for this purpose. Eight of the museums maintained expeditions for collection or research, and these cost in the aggregate $48,544. Nine institutions expended a total of $58,118 in the publication of researches, and twelve expended a total sum of $13,895 for books, pamphlets and binding. In other words, in these sixteen museums we find that 51 per cent. of their income came from public grants, and 49 per cent. from private sources, while 51 per cent. of their total income was expended in salaries and wages. Where the amounts are known, an average of 6.1 per cent. of their income was expended for specimens, 4.9 per cent. for expeditions, 5.7 per cent. for publication of researches and 1 per cent. for books, pamphlets and binding; leaving 31.3 per cent. for maintenance, repairs, cases, installation of collections, etc.

The museums under political auspices, whose employees serve under civil service rules, show poor economy in their management in comparison with that of museums whose finances are managed by boards of trustees not subjected to political influences, and who have full control over the administration of public or private funds, with power to appoint and discharge all museum employees under rules of their own making.

Name of Museum.	Year Ending	Total Per cent. Paid for Salaries and Wages.	Per cent. Paid for Salaries of Scientific Staff and Preparators.	Per cent. Paid for Salaries of Clerical Staff, Laborers and Guards.	Per cent. Paid for Specimens.	Per cent. Paid for Expeditions.	Per cent. Paid for Books, Pamphlets and Binding.	Per cent. Paid for Publication of Researches.
National Museum.......	June 30, 1901.	66	24	42	4.6		0.7	4 7
American Museum of Natural History......	Dec. 31, 1901.	45			10.2	9.6	0.6	5.4
Field Columbian Museum	Sept. 30, 1901.	53	31	Janitors, guards, labor, 22.	6.9	7.4	0.4	2.5
Carnegie Museum of Natural History	March 31, 1902.	52			13.6	8.2	2.2	5.1

For example, the four institutions under civil service rules expended from 45 per cent. to 75 per cent. of their incomes in the payment of salaries and wages, the average being 63.7 per cent.; whereas the twelve museums not under civil service regulations expend from 25 per cent. to 66 per cent. in salaries and wages, the average being 45 per cent. or 18.7 per cent. lower than that of the institutions under the civil service.

A fair example of the general lack of economy of civil service administration in our museums is illustrated by a comparison of the expenditure of our National Museum with that of three non-political institutions,

such as the American Museum of Natural History, the Field Columbian Museum and the Carnegie Museum of Natural History in Pittsburgh.

This comparison appears fair, owing to the fact that the management of our National Museum is more economical than that of many other prominent museums under political auspices.* The results are presented in the table on previous page showing the percentage of total income devoted to various purposes.

In general, it appears that museums under political control expend more for salaries and wages and less for specimens than do those whose management is entrusted to boards of trustees who have power to appoint and discharge employees independent of civil service rules. Museums under civil service rules, however, expend relatively more for books and pamphlets, and more for the publication of research, than do public museums not under political control.

The museums of universities or of learned societies, however, lead in the proportionate amount devoted to the development of their libraries and to publication of original research, and these institutions have in our country contributed to the advancement of science and education in a ratio wholly disproportionate to their relatively meager income.

An analysis of the expenditures for salaries and wages in our museums under civil service shows that in general they pay much more for the services of clerks, guards and laborers than for the salaries of men of science, artists and skilled preparators, while the reverse is the case in museums under other auspices. The museums of colleges are most economical in their appropriation for salaries, but in many such museums the lack of curatorial work upon the collections is very apparent, and renders their educational value insignificant in comparison with that of collections which have received more attention in labeling and arrangement. Also the universities often rely, to a considerable extent, upon the services of unpaid curators, who devote only a portion of their time to museum work and whose spasmodic efforts are, on the whole, unsatisfactory.

As Sir William Flower* aptly states: "What a museum really depends upon for its success and usefulness is not its building, not its cases, not even its specimens, but its curator. He and his staff are the life and soul of the institution, upon whom its whole value depends."

Specimens are materials only; their usefulness depends upon what is done with them. Our museums can do no better than to obtain the services of men of the best scientific training and efficiency. We require better rather than more men. Museums from their nature afford exceptional opportunities for study, research and exploration, and may be made peculiarly attractive as fields of labor for men of science who desire to increase knowledge. The leading men of science in our country should be found in the museums, but a narrow policy in the granting of opportunity for research, exploration and publication, and the general poverty of our museums, have confined them largely to our universities, where their efforts are devoted to elementary teaching rather

* The National Museum being the repository for all collections made under the direction of government, is not obliged to maintain expeditions under its own auspices. The sum of $2,016, or 0.7 per cent. of its total income, was devoted to 'travel.'

* 'Essays on Museums and Other Subjects Connected with Natural History,' London, 1898, p. 12.

than to productive scholarship,* and this condition will hardly improve until our universities can afford to appoint professors who shall lecture exclusively to the students of the graduate school.

As a whole, our museums expend too small a proportion of their resources upon the development of their more serious aims, such as the maintenance of learned libraries, the publication of research and encouragement of exploration. The great majority of our museums contribute little or nothing to the direct advancement of knowledge, either in publication of original work, or in the maintenance of lecture courses given by acknowledged masters. Moreover, the installation, arrangement and labeling of their collections, and economy in expenditure leave much to be desired. It is true that all of these deficiencies are in a measure traceable to the poor support which our museums receive from public funds, a fact which is apparent when we consider that the British Museum in 1897–98 received a public grant of about $812,000 or more than the entire public support given more recently to sixteen of our best museums whose finances we have been considering.

In European countries the state of civilization and development of culture of each nation is certainly commensurable with the development of its museums. Measured by this standard, the United States compares unfavorably with other civilized countries.

This investigation appears to show that the average well-managed museum in the United States devotes one half of its annual income to salaries and wages, one third to maintenance, installation and repairs, and only about one sixth of its income to expeditions, library, publications of research and purchase of specimens.

ALFRED GOLDSBOROUGH MAYER.
MUSEUM OF THE BROOKLYN
INSTITUTE OF ARTS AND SCIENCES.

* An excellent exposition of the inefficiency of our universities as centers for the production of research is given by Hugo Münsterberg, 'American Traits from the Point of View of a German,' Chapter III., 'Scholarship,' 1901, Houghton Mifflin and Co.

*MONTANA AS A FIELD FOR AN ACADEMY OF SCIENCES, ARTS AND LETTERS.**

IT seems appropriate at this meeting, the first in the history of the work of the Montana Academy of Sciences, Arts and Letters, to discuss the opportunities for work in the state, rather than to take the discussion of some problem or phase of work, tempting as the latter may be. In this day of many societies and organizations, when each line of work has its own organization, with a membership composed of those directly interested in the work fostered by the organization, it would appear that new organizations and societies should not be brought into existence without good reasons for so doing. Let us present some of the reasons for the organization of this academy.

In organization lies strength. According to the laws of physics, if a thousand separate forces act upon an object from different directions the object will move in the direction of the component of all the forces and with the force exerted by it. This component may be smaller than any single force, when the forces act against each other. Or it may be the sum of all of them when they act together. Each human being may be considered to represent a force. The sum total of progress represents the combined action of all the forces of the different units, human beings. When the work is concerted and not antagonistic, progress is rapid. When every

* Address delivered at the first meeting of the Montana Academy of Sciences, Arts and Letters, at Bozeman, Montana, December 29, 1902.

man is at war with his neighbor advancement is slow.

The strength of organization has long been recognized. The political 'machine' may not number many politicians, but its power is well known. Church organizations have for centuries been powerful agencies among men, controlling both thought and action. Capitalists organize, making many monopolies into one gigantic monopoly, and threatening the peace of the world. Nations form alliances for protection. Laborers unite as a unit to bring about reforms and better to protect themselves from abuses of employers. The wave of organization is sweeping onward with great force. Nothing to-day promises success without organization and concerted action. Proof of this is the great number of societies of various kinds, with titles expressive of their importance and work.

This banding together of human beings for mutual good is usually of two grades or degrees, *i. e.*, local and state or national. Local associations deal with affairs immediately at hand. State and national societies discuss subjects broader and more far-reaching in scope, omitting such details as refer to single localities. There is thus a double tie of strength in organization. The strength of the national or state society is measured in great part by the strength of the local associations. Each aids and supports the other.

If the foregoing is sound reasoning there is much to be expected from such an organization in the state as that proposed in the Academy of Sciences, Arts and Letters. The teachers of the state have their state association, with its various departments. With this we do not wish to interfere. The agriculturists, wool-growers, cattlemen, horticulturists, laborers of various callings, physicians and others have their local and state organizations or both, in order the more effectually to accomplish the work the individual members see should be done. By such an association an individual idea soon becomes common property. The good things are quickly sifted and are pressed by the power of the whole association instead of by the individual who first conceives them.

Most of the great achievements of the world have come about through exchange of ideas. The occasional meetings of kindred spirits for the discussion of topics in which there is mutual interest are productive of far more good and are much more effective than is usually considered. At such gatherings there is an unusual stimulus for thought. Business or professional cares are subordinated to the work of the association, and the thought and attention are directed solely to the subjects presented. A single suggestion from some paper may start a flow of ideas which may develop into work of vast importance. Often it happens that at such gatherings are found men and women so full of suggestive ideas that it is impossible for one person to operate them all. Those less fertile in originality may receive suggestions which otherwise could not possibly be obtained. This exchange of ideas is all important in such gatherings as this, and its value can not be over-estimated.

We can not live without friends. If we were cut aloof from the aid and companionship of our fellows life would be profitless. It is give and take. Some give more than they take, others take more than they give. It is certainly true that the wider one's circle of friends and acquaintances becomes the greater is the opportunity for giving and receiving ideas and suggestions, hence of receiving help and becoming a helper. Occasional fraternal gatherings widen one's circle of friends, bind closer the bonds of unity in work,

give new inspiration for work and added stimulus for greater effort.

Everywhere among educational men is heard the urgent call for investigation. Trained investigators are sought on every side. Investigation is demanded of college professors by governing boards. It is inspired in students. The investigators make the world move. They are the leaven that moves society to demand social reforms. They open new fields for commerce. Educational reforms are suggested by them. To them we look for the alleviation of diseases, for the control of pestilences. If the fabled fountain of immortal youth is ever found it will surely be through the efforts of this noble class of men. They have practically banished the curse of yellow fever in the tropics; by their efforts the Oriental fruits are grown on the opposite side of the earth; electricity has by leaps and bounds, at their magic touch, entered almost every occupation of civilized man; by their unflagging efforts the unwritten history of past ages has become common property; space has been annihilated by their inventions; the farmer, the fruit-grower, the merchant, the lawyer, the laborer, all must acknowledge the powerful influence exerted by the investigators.

Division of labor is being differentiated very rapidly during the last decade. The pressure for specialization in occupations and professions is fast driving men into one single phase of a subject for an occupation. This differentiation of occupations and division of labor will become more and more circumscribed and complex as the years go by. Each new discovery and invention multiplies the possibilities of increased work ten, twenty or a hundredfold. The specialist who by continued investigation adds new ideas and new inventions to the world's large list benefits the race by so doing, and adds luster to his name and nation. But at the same time he draws more sharply the line that marks the life work of his successors. His work is demanded. It indicates the highest degree of mental activity. It demands a fertile brain, a vivid imagination, a philosophical mind, a benevolent and humanitarian nature.

It is not to be expected that every investigator in the state should be a member of the academy, but certainly every member of the academy should be an investigator. Each person should have some one idea, or several ideas, which may demand original work, whether it be in the field of science, arts or letters. The meetings of the academy should be given up almost entirely to reports of work in progress. They should be the means of making public the work of investigation carried on by the members, and no paper should be considered too technical for presentation.

The object of the Academy is stated in Article II. of the constitution.

"The object of the academy shall be the promotion of sciences, arts and letters in the state of Montana. Among the special objects shall be the publication of the results of investigation, the formation of a library, and the promotion of a thorough scientific survey of the state."

This is a broad and liberal field for action. It may be appropriate here briefly to summarize some of the opportunities presented to the members of the academy in the state of Montana.

The state contains approximately 146,000 square miles of territory. About one third of this is agricultural land, either in cultivation or capable of being cultivated by the use of water; one third is grazing land, either too remote from water for irrigation or too uneven to permit the use of water; the remaining third is mountainous.

The state is almost three times the size of either Iowa, Wisconsin, Arkansas, Alabama, North Carolina, New York, Mississippi or Louisiana; it is 140 times the size of Rhode Island, 75 times as large as Delaware, 30 times the size of Connecticut, 20 times the size of New Jersey, 18 times the size of Massachusetts, 16 times that of Vermont, 14½ times that of Maryland, 6 times that of West Virginia and almost five times the size of Maine. Its area equals the combined areas of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New Jersey, Delaware, Maryland and West Virginia; or of Nevada with Pennsylvania thrown in; or of Virginia, West Virginia, Ohio and Kentucky. It is about 600 miles from the eastern to the western end of the state, 722 by the Northern Pacific Railroad.

The climate varies from the moist and heavily timbered belt in the west to the dry arid plains in the east; from the cold northern boundary to the mild western and southern area, with boreal regions along the mountain chains.

The scenery of the mountainous regions is sublime. Numerous lakes, flanked by towering mountains, tempt the artist who is skillful with the brush. Broad valleys with winding streams alternate with mountain ranges with untold agricultural, mineral and lumber wealth.

The hardy pioneer, the vanishing redman, the scenic beauty of the state, the undeveloped natural history resources and the remarkable geological beds offer a rich field for the novelist, the ethnologist, the historian or the scientist. The number to undertake the work is small. The field is large. There is a wide range for selection. Within a decade the work will be much more circumscribed. It should be a part of the mission of the academy to call the attention of the people of the state and of the world at large to the marvelous resources of the state, and to aid in their development.

Permit me to suggest a few ways in which the academy may be of value in the state.

One of the most necessary lines of work to be accomplished, and in time the first to be undertaken, is to discover what is present in the state. It is impossible to begin work without knowing what the work is about. To determine the distribution of shells necessitates the preliminary work of collecting and identifying species. To discuss vertical range of vegetation on mountains or horizontal range on the plains demands a large amount of hard work in digging, drying, transporting, and mounting numerous collections of specimens, as also their identification.

In this connection it may be stated that there are many important localities in the state to which the collector has not yet made a visit. It may, therefore, reasonably be expected that many of the first scientific papers in natural history and geology will be lists of collected material from limited localities. These are specially desirable and are of prime importance. In geology we may reasonably expect descriptions of mountains showing special structure, discussions of river and lake beds, reports on rocks and minerals, with lists and descriptions of new fossils. We may certainly expect from time to time that those gifted in photography may present slides illustrating the natural scenery, and it is certainly in reason to expect from time to time exhibits of work with the brush, whether they be of topography or natural history matters little.

The academy should pick up the younger individuals and put them to work. It is to them we must look for recruits. They need help. There are in every locality

many persons who are anxious to carry on some work involving original study. It should be fostered in every individual. There are few people who do not in early life have a love for nature. Unfortunately for the large number, this natural tendency to inquire into nature's secrets is smothered by the many other forms of mental activity in which they must engage. This natural tendency, if properly directed and stimulated, may be the beginning of more important studies in science, or art. Our state is young. It is no discredit to say the work of science and art within its borders is not extensive, indeed, is small. But the opportunity is here and all that is necessary is to mass the forces, bring in all those with a desire for work and give them encouragement, and work to a common end.

The academy should seek avenues for advertising the scientific, artistic and literary opportunities presented by the state. There should be no selfish motives in any work undertaken. With a state as large as this there is abundant room for a large number of skilled workers. What the state needs is men of money and men of brains. The former for the establishment of those industries necessary to develop the state, the latter to seek out new lines of development. Tens of thousands might come in, and still the field would scarcely be touched. This end may be accomplished by articles in the daily and weekly press. Rarely is an intelligent article relative to the state refused by the brethren of the newspaper fraternity. Those more gifted may prepare articles for the more pretentious magazines. Pictures of local artists should be purchased and, if possible, distributed. Books and magazines should be purchased. It is not a very encouraging sign to see so excellent a local publication as the *Rocky Mountain Magazine* die for lack of support. There are many ways in which the state may be advertised, and each individual must use his own judgment as to the best means at his disposal.

The academy should devise means for disseminating the knowledge presented by members at the regular meetings in the papers and discussions.

The earlier history of the California academy is worth recording. During its first years it commanded but little attention. Record of its business and abstracts of papers were given to the public through the medium of the daily press. Now the academy is one of the strongest in the United States, and its publications are of a high order and quite numerous. The publications of the Montana Academy should be issued by the state as state documents. The means of the academy will be limited for some years. If the state's material resources are developed by members of the academy the people of the state should be willing to bear their proportion of the expense, since the work of investigation is gratuitous. If papers in pure science, arts or letters are presented, these should be printed on the ground that all such work is for the advancement of human knowledge. The work of the one preparing the paper is much greater than that necessitated by each taxpayer for its dissemination. The distinction between the practical and theoretical can not be drawn. The theoretical often becomes practical, and neither can do without the other. All papers of importance, therefore, should be printed. With proper safeguards, the publication of the transactions of the academy should be an honor to the state and of great value to its citizens. I suggest that this academy recommend to the legislature the enactment of a law for the printing of the transactions of the academy as state documents.

The academy should foster the organization of a state geological and natural history survey. There is no reason why such a survey should not be begun in the state at an early date. The state is in a prosperous condition. Its prosperity is increasing annually. The portion of the state covered by the United States Geological Survey is very small and does not include much of the work which a state survey would no doubt cover. The work of the state survey should, so far as possible, be carried on conjointly with that of the United States survey. The expense at first need not be great. With a moderate beginning, increased annually as the state prospers, the survey could do a very great service in working out the resources of the state. No doubt but that much of the preliminary work could be done without salaried men and with nothing more than the payment of field expenses by the state. The results of the field workers should be printed as state documents. The survey should be under a governing board free from politics, consisting of men representing the various state institutions, the state scientific organizations and the governor. Every member of the academy should use his influence to have such a survey inaugurated. If the question is properly agitated the survey is likely to be organized.

The academy should aid in the protection of those relics of the past which are of common value and interest to the people of the state. I refer to the preservation of the forests, fish and game, and of historic places and objects. The sentiment for game and fish protection in the state is small. I make this statement after careful deliberation and several years of close study of the question. There is a *desire* for game protection, but little *sentiment.* The minimum penalty is usually imposed on the offender, and not infrequently the penalty is less than the amount specified by law. The members of the academy should be radiating centers from which sentiment emanates for game and fish protection. They should have a keen eye open for the senseless persons who ruthlessly slaughter song birds in the vicinity of cities or towns. There are in the state many places of historic interest. The members of the academy should be on the alert for such and should use diligent effort to have them preserved. Historic relics grow more valuable with age.

There is need for the academy to lend some assistance toward getting more and better work done in the sciences in the schools of the state. The natural and physical sciences are more inadequately presented in the high schools of the state than other subjects. The condition is much better than it was a few years ago, due in large measure to the adoption of a state course of study, in which a year of chemistry was first required and later a year of biology. The natural growth of cities has demanded better facilities and more extended curricula, another factor in the development. But there is much room yet for improvement. I do not know of a school in the state that has manual training as a part of its work.* Drawing is not required in the high school. The laboratories are confined chiefly to chemistry and physics, although microscopes are being added in several places. The members of this association should lend their influence in the different cities to having better scientific equipment, to the introduction of manual training and to the employment of teachers specially fitted for special work, after the most approved scientific and pedagogical methods.

* Since writing the above I am informed that manual training has been introduced into the Glendive schools.

Each member of the academy should engage in some work which promises fruitful results, and which will in a measure bring recognition for the work. No individual should be satisfied in his present condition. Each person should strive to add something to the world's store of knowledge.

If an organism should cease to make effort when the fatigue point is reached, there could be little advancement in power or progress. If the inhabitants of the world should cease to press in search of the unknown, progress would cease. We can not remain in a fixed condition. We must press forward or fall backward. The masses of mankind are carried forward by the efforts of the few. The greatest triumphs of the century soon become the common property of the people. With the rapid increase of knowledge and the present great differentiation of labor one must seek a limited field and drive some subject hard and increasingly. Membership in this academy indicates a desire to carry on progressive work. The coming annual meetings will give the results of the individual efforts.

In this brief sketch I have but hinted at some of the reasons for the existence of this organization, and have suggested some of the ways in which, as it appears to me, the academy may do good in the state. There are many others yet unrecounted. But if I have encouraged the members to greater individual effort and have led them to feel they are not alone, although a hundred miles from those in sympathy with the work, I shall be satisfied. Montana is not yet out of touch of pioneers. The old hunter and trapper has almost disappeared. The population is fast becoming stable. The pioneers are now those first to take up the work incident to the development of the educational and esthetic life of the people. For the accomplishment of this end the Academy of Sciences, Arts and Letters takes its place with other organizations. Its life and work will represent the activity of the members which shall make up the organization. May it have a long and useful life.

MORTON J. ELROD.

UNIVERSITY OF MONTANA.

SCIENTIFIC BOOKS.

A Manual of Zoology. By RICHARD HERTWIG. From the fifth German edition. Translated and edited by J. S. KINGSLEY. New York, Henry Holt & Co. 1902. 8vo. Pp. 704.

An English translation of the whole of this valuable manual has been needed, though we had from Dr. Field a good translation of the first or general part. Professor Kingsley has now added a translation of the second, the whole volume well rounding out the series of superior text-books of zoology now at the service of the student and teacher. With two such text-books as Parker and Haswell's 'Zoology,' and the one before us, the zoologist of the present day is fortunate.

Although we are not sure but that, for the student or beginner, the general principles of modern zoology should follow the description of the types or of the principal groups, it is safe to say that the student will nowhere find such a valuable, concise, comprehensive and reliable statement of the general subject as in this volume. It comprises not only a history of the science in nearly all its phases, but the philosophy of zoology, a subject now very much needed for students who are perhaps too early led to specialize. One might wish that the matter of geographical distribution could have been edited with reference to that of North and South America, and that more space could have been given to ecology or bionomics. But the subject covers so broad a field, and on the whole is treated in so equable a manner, that this may seem a superfluous criticism.

In the history of the evolution theory the statement is made that 'Lamarck, in accordance with the then prevailing conceptions,

regarded the animal kingdom as a single series grading from the lowest primitive animal up to man.' This is a mistake. Hertwig could never have carefully read what Lamarck did say, or have known that he was the first to throw aside a serial arrangement and to sketch out a two-branched genealogical tree of the animal kingdom as he knew it. Lamarck, on the contrary, says, referring to the existing animals: 'I claim that they form a branched series,' etc.

The translation uses the word 'rudimental' for vestigial. On page 180, in enumerating the classes represented in the Cambrian period, the brachiopods are omitted, and only six classes in all are enumerated, whereas there are the remains of the representatives of thirteen or fourteen.

The portion on 'Special or Systematic Zoology' is a very useful summary of the characters of the phyla, classes and orders, and in some cases of the suborders and families. Of course, in the matter of classification zoologists even now differ very much. While in the first edition of the original work (1892) the animal kingdom is divided into only seven phyla, there are in the present translation ten. Professor Kingsley has made important changes from the German edition in the classification of the arthropods. He has done well to assign the sponges to a separate phylum (Porifera). The Mollusca are made to precede the Arthropoda. We are unable to follow the translator in placing the Trilobita among the Crustacea, and in separating the Gigantostraca (why not Merostomata, which has the priority by many years?) from the Trilobita. On the other hand, the Merostomata are not included in the Arachnida as is done by some English zoologists. For Trilobitæ Trilobita is preferable, as it is the original spelling of McLeay in 1840. Trilobitæ is the term given by a later author.

The Myropoda are very judiciously treated, and we quite agree with Professor Kingsley in breaking up the old group Myriopoda into two groups, placing the Diplopoda, with the 'Pauropida' (*sic*) apart from the Chilopoda. With the classification of the insects we should have some fault to find; certainly the Rhynchota should not be placed in so high a position between the Hymenoptera and Diptera. The Lepidoptera are divided into six suborders, a singular arrangement allowed to remain over from the German text, without change. More modern views might have been adopted in the translation.

A few slips or errors remain to be noticed which could be corrected in a second edition, which we doubt not will soon be called for. Did not Ledermüller speak of 'Infusionsthiere' a little previous to Wrisberg, who called the infusoria 'Animalcula infusoria'? The use here and there of the word 'ringing' for segmentation is not happy. In the too brief account, to be very useful, of *Pithecanthropus* mention is made of 'a molar tooth,' whereas three have been found.

There is a commendable absence of typographical errors. We have only noticed 'trocophere,' page 316; 'correllate,' page 389; 'chelefer,' page 450, and 'Pauropida,' on page 497. The copy we have before us is rather faintly printed, and the cuts are not always evenly printed.

A. S. Packard.

EUCALYPTS CULTIVATED IN THE UNITED STATES.

Bulletin 35 of the Bureau of Forestry, U. S. Department of Agriculture, is a handsome volume devoted exclusively to Professor McClatchie's valuable memoir on the 'Eucalypts Cultivated in the United States.' It is profusely and beautifully illustrated, well printed on good paper and every way worthy of all concerned in its production. Above all, it is a timely publication, particularly so when the need of southern California is considered in the matter of fuel. With the extraordinary increase of population in this part of the state follows a corresponding increase in the demand for fuel. The supply furnished by the native trees, red and white oaks, juniper, mesquit, etc., is rapidly diminishing; already the eucalypts, principally *E. robusta* and *E. globulus,* contribute one half or more of the wood fuel. Coal, gas, gasoline and kerosene are largely used; nevertheless, the demand for fire-wood is constantly increasing. Not infrequently the daily papers notice the

planting of new areas in various places, some of large extent; it is very doubtful, however, whether the increase in acreage devoted to the eucalyptus is sufficient to meet the wants of even the immediate future. The present prices are not likely to decline. At $10 to $11 for the native woods, per cord of 96 cubic feet (that is to say, three tiers of stove lengths, eight by four feet otherwise) and $7.50 to $9 for eucalyptus or gum-wood, as it is popularly called, there is a handsome profit in the cultivation of the latter, for after the first cutting these trees sprout or start again from the stump, and a second cutting can be made in five or six years. The above prices are the retail figures; the discount to the 'wood yards,' is probably not more, on an average, than one dollar per cord, while the retail prices at the 'yards' are much higher than those above stated, for small quantities. The numerous species of these invaluable trees include forms adapted to a great number of purposes in the mechanical arts. It is principally as fuel, shade trees and wind-breaks that they have been used in this country. I have not learned of an instance of their use in the manufacture of lumber. To a limited extent certain species have been used as piles in wharf structures, and it is not unlikely that these may be found to be immune against the ravages of *Chelura* and *Teredo*. The medicinal value of *E. globulus* and other species is above dispute and has been for many years; their use in this direction deserves to be widely extended. The experience of the writer at various times in serious gastric troubles has proved to him their unquestionable medicinal virtues. Again, the bulk of testimony is in their favor when the neutralizing of malarial atmospheric conditions is considered; their beneficial action, or rather the action of certain species, can easily be shown. As Professor McClatchie says: 'The eucalypts probably serve more useful purposes than the trees of any other genus grown on the globe, except possibly the various palms.'

In the professor's memoir some forty or more species are described in a popular way, their characteristics, climatic requirements and uses given. These forms are illustrated by numerous finely executed half-tone engravings, and otherwise presented in a very useful way by grouping of species according to climatic adaptation and uses. Then follow a 'key' and technical botanical descriptions. The bibliography and index close the volume.

Both the bibliography and the history of *Eucalyptus* culture in California are open to criticism. The highly creditable work of Mr. Elwood Cooper and Mr. Abbot W. Kinney in promoting by precept and practice *Eucalyptus* culture in southern California is justly praised. Of the former, in referring to a lecture delivered by him in Santa Barbara in 1875, it is said: 'This was probably the first address on the subject in America.' By turning to the 'Proceedings' of the California Academy of Sciences it will be seen that on the first day of July, 1872, the writer read a paper, 'On the Economic Value of Certain Australian Forest Trees and their Cultivation in California,' the lecture being printed in full in Volume IV. of the Academy's proceedings, the same is contained in the 'Annual Report of the State Board of Health for 1872,' and about the same date a pamphlet edition of 2,500 copies was published and distributed gratuitously. In connection with this, see also the New York *Nation* for August 22, 1872. Subsequently to the Academy's Proceedings the late Dr. Albert Kellogg contributed a paper on the eucalypts; still later a paper on 'Forest Tree Culture in California' was read before the American Forestry Association at the Cincinnati meeting, April, 1882, and published in the report of that meeting. The late Colonel Warren's *California Farmer,* the first agricultural paper published on the West Coast, contained, first and last, many articles on the foregoing subject. Professor McClatchie's memoir has but little, very little, to say about *Eucalyptus* culture in California north of Tehachapi, or, in other words, latitude 35°; yet north of this general line hundreds of thousands of these trees have been planted throughout a far larger territory, embracing more diversified climatic conditions than southern California.

The extensive plantings made by the Southern Pacific Railroad in the San Joaquin Valley region over twenty years ago and the lessons indicated thereby are not mentioned. General Stratton's forty-five acres in *E. globulus* and *E. viminalis* planted in 1869 in Alameda County, probably the first artificial forest west of the Rocky Mountains, seems to have escaped notice. The late B. B. Redding, for many years land agent of the Central Pacific Railroad, and Professor E. W. Hilgard, of the University of California, and others have written and preached much on the general text.

A useful addition to Professor McClatchie's memoir and one in harmony with its general scope would be a climatic map similar to that published some years ago by the Southern Pacific Railroad Co. In this the thermal zones of the state are exhibited; these zones are governed by topographic features and can not be understood by reference to latitude. One word more as to the propagation of the eucalypts from seed. Judging by my own experience from imported seed, *E. amygdalina* and *E. robusta* germinated as readily as radish or turnip seed, when sown in a cold frame.

ROB'T E. C. STEARNS.

LOS ANGELES,
February 21, 1903.

SCIENTIFIC JOURNALS AND ARTICLES.

THE April number of the *Botanical Gazette* contains two cytological papers. The first is the beginning of an article on 'Oogenesis in *Saprolegnia*,' by Professor Bradley M. Davis, in which he presents newly observed facts regarding the formation of the egg and the behavior of the cœnocentrum. The concluding part of the paper will be devoted to theoretical considerations. The second is by Professor David M. Mottier, on the 'Behavior of the Chromosomes in the Spore Mother-cells of Higher Plants and the Homology of the Pollen and the Embryo-sac Mother-cells.' He describes mitoses in the microspore and megaspore mother-cell of typical angiosperms, and homologizes these processes. The occurrence of a single megaspore is regarded as a derived condition, four being the primitive number. In continuing his notes on North-American grasses, Mr. A. S. Hitchcock describes as a new species *Willkommia texana*. In view of the fact that the concluding paper in Professor F. O. Bower's important series on the 'Morphology of Spore-producing Members' is not likely to be published in full for some months, the editors have published in advance an abstract of the memoir, which contains a general discussion of the results reached in the four previous papers of the series, and of their bearing on a theory of sterilization in the sporophyte. MacDougal's memoir on the 'Influence of Light and Darkness upon Growth and Development of Plants' and Graebner's volume on the 'Heaths of Northern Germany,' are reviewed, together with other current literature. Among 'Notes for Students' Mr. J. Arthur Harris contributes a review of recent teratological literature.

THE May number of the *Biological Bulletin* of the Marine Biological Laboratory contains the following articles:

HELEN DEAN KING: 'The Formation of the Notochord in the Amphibia.'

LEO LOEB: 'On the Coagulation of the Blood of some Arthropods and on the Influence of Pressure and Traction on the Protoplasm of the Blood Cells of Arthropods.'

S. J. HOLMES: 'Phototaxis in Volvox.'

SOCIETIES AND ACADEMIES.

THE SAN FRANCISCO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE third regular meeting of the San Francisco section of the American Mathematical Society was held at Stanford University on April 25, 1903. Fifteen members of the society were present. Professor Haskell was elected to succeed Professor Wilczynski on the program committee. The following papers were read during the two sessions of the section:

PROFESSOR E. J. WILCZYNSKI: 'Invariants of systems of linear partial differential equations, and the theory of congruences.'

DR. D. N. LEHMER: 'Preliminary report on a table of smallest divisors.'

PROFESSOR H. F. BLICHFELDT: 'Note on linear substitution groups of finite order.'

PROFESSOR R. E. ALLARDICE: 'On some curves connected with a system of similar conics through three points.'

DR. SAUL EPSTEEN: 'Necessary and sufficient condition for the existence of invariant subgroups.'

PROFESSOR G. A. MILLER: 'On reciprocal groups.'

DR. H. C. MORENO and PROFESSOR G. A. MILLER: 'On the non-abelian groups in which every subgroup is abelian.'

MR. W. A. MANNING: 'On the class of primitive substitution groups.'

MISS IDA M. SCHOTTENFELS: 'Generational definition of an abstract group simply isomorphic with the simple substitution group $G_{20160}{}^{21}$.'

DR. T. M. PUTNAM: 'Certain subgroups of the quaternary linear fractional group of determinant unity, in the general Galois field.'

The paper by Dr. Epsteen was presented by Professor Wilczynski. The secretary read the paper by Miss Schottenfels. The other papers were presented by their authors. The next meeting of the section will be held in December at the University of California.

G. A. MILLER,
Secretary.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

AT the meeting of the section on May 4, Professor Ernest R. von Nardroff read a paper on 'A New Interferometer Method for Measuring the Refractive Index of a Transparent Plate.'

This method was planned to avoid the use of compensation, which leads to grave errors unless in the compensating material the ratio of the velocities for any two wave-lengths is the same as in the substance being measured. It is frequently impracticable to fulfil this condition, as for example by using as a compensator a second plate of the same material. Air compensation is of course out of the question.

In the present method, in which no use is made of white light fringes, the transparent plate, a microscope cover-glass for instance, is mounted on a special stage perpendicular to the path of one of the beams in a Michelson interferometer. With sodium light, bands are seen that are generally distorted through lack of perfect parallelism between the surfaces of the plate. The stage is now rotated forward about a vertical axis through an angle of 45° up to a fixed stop, thus increasing the path through plate. Slowly turning the stage backward, the bands passing a fixed point in the field are carefully counted until the plate returns to the perpendicular position, when the motion of the bands reverses. A new count is now made while the stage is turned past the perpendicular, backward 45° to a second fixed stop. Generally these counts differ by a few tenths of a band, owing to imperfect mounting of the stage as a whole on the interferometer, but they may be averaged without sensible error. Since the light passes through the plate twice, one half the number of bands counted should be taken to represent the increase of optical path, N. The thickness, t, of the plate at the part of it observed in the interferometer may be measured by means of a micrometer caliper or a spherometer. The following exact formula, much simplified through the use of precisely 45° of rotation, gives the value of the refractive index, μ.

$$\mu = \frac{\frac{1}{2} + \left(1 - \sqrt{\frac{1}{2}} - \frac{N\lambda}{t}\right)^2}{2\left(1 - \sqrt{\frac{1}{2}} - \frac{N\lambda}{t}\right)}$$

For sodium light where the wave-length, λ, is 0.0005893 mm.

$$\mu_{Na} = \frac{0.5 + \left(0.2929 - \frac{0.0005893\,N}{t}\right)^2}{2\left(0.2929 - \frac{0.0005893\,N}{t}\right)}.$$

This method has been extended to the measurement of doubly refracting plates, such as mica. The plate must contain in its plane at least one of the axes of the so-called ellipsoid of elasticity, and must be mounted with this axis vertical. The bands may be observed through a Nicol prism having its shorter diagonal vertical.

A second paper was presented by Dr. G. B. Warring, on 'Some Peculiarities of the

Gyroscope,' in course if which were given some interesting experimental details observed from experiments carried out by Dr. Warring. These experiments are to be performed before the academy, at a future meeting. S. A. Mitchell.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

April 24.—In reference to some original work Dr. Julien reviewed a paper by August Rosiwal, 'Ueber geometrische Gesteinsanalysen,' from the Verhandlungen der Kaiserlich-Königlichen Geolog. Reichsanstalt for 1898.

May 1.—Mr. H. C. Magnus reviewed Bulletin 56 of the New York State Museum. The Bulletin gives many interesting data concerning the 1901 state geologic map. It also gives an excellent review of the geologic surveys of the state, with a table at the end correlating the terms used by the different surveys. Professor Kemp reviewed from the *American Journal of Science,* April, 1903, 'The Mechanics of Igneous Intrusions,' by R. A. Daly.

May 8.—Dr. A. F. Rogers reviewed 'A Three-circle Goniometer,' by G. F. Herbert Smith; Mineralogical Society of London, vol. 12, 1900. Miss Florence Henry reviewed 'The Animal Ecology of the Cold Spring Sand Spit,' by C. B. Davenport. Dr. Geo. I. Finlay reviewed Bulletin 182, U. S. G. S. This bulletin, by F. L. Ransome, treats of the 'Economic Geology of Silverton Quadrangle, Colorado.' Professor Kemp called attention to the 'Geology of the Celebes,' by Professor Bücking, and to Bulletin 213, U. S. G. S., on the economic geology for 1902. This contains the abstracts of some papers not yet issued by the survey. H. W. Shimer.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 345th regular meeting was held April 14. Professor Friedrich Hirth, of Columbia University, occupied the evening, reading a paper entitled, 'The Early Development of Chinese Civilization.' Professor Hirth exhibited examples of early Chinese art and explained the symbolism and the hieroglyphic characters that are found on ancient works of art and their relation to modern characters. The inception of Chinese culture Professor Hirth places at the second millennium B. C., noting the unreliability of Chinese written accounts as to the early times. About 120 B. C., Bactrian Greek art influence found its way into China, of which examples were shown consisting of designs on the backs of metal mirrors and of rock carvings. The developments of architecture, writing and printing were traced. Professor Hirth affirms that in art Japan stands entirely on the shoulders of China. The paper was discussed by Messrs. Flint, Spofford and McGee. A vote of thanks of the society was tendered Professor Hirth for his instructive paper.

Walter Hough,
Secretary.

DISCUSSION AND CORRESPONDENCE.

A TROPICAL MARINE LABORATORY FOR RESEARCH.

To the Editor of Science: The subject which Dr. A. G. Mayer has so ably introduced for discussion under the above title is of such importance as to call for careful consideration from biologists. It is also beset with difficulties of a peculiar character, the recognition of which will largely determine its success or otherwise. Of the desirability for such a permanent laboratory and of the great results to biology which would accrue from its establishment there can scarcely be any divergence of opinion. Granted the means for its support the primary discussion will center around the best means for attracting the greatest number of able workers, involved in which is the important question of the most suitable site.

The suggestion for the establishment of a biological laboratory in the tropical Atlantic is by no means new. Ten or more years ago the subject received the public support and encouragement of the late Professor Huxley and Professor Ray Lankester, and was discussed in the English *Times* and various scientific journals, while the Institute of Jamaica has at times made recommendations of a like character.

Three or four years ago a committee of American botanists, composed of Professors D. H. Campbell and D. F. MacDougal, visited

various islands of the West Indies with a view to the selection of a suitable spot for a tropical station. In the end Jamaica was practically determined upon, when the sad death of an American botanist and zoologist in the island resulted in a suspension of the efforts. Within the past two years the Commissioner of the Imperial Agricultural Department for the West Indies, Dr. D. Morris, C.M.G., has endeavored to secure assistance from the Imperial and local governments for the establishment of a marine section to his department, at which biological research could be conducted, but as yet without much encouragement, owing to the depressed financial condition of the islands.

As in so many instances one turns for a ray of hope to the trustees of the Carnegie Institution. But before this beneficent organization can be approached it is manifest that the scheme should be thoroughly discussed and some consensus of opinion reached by biologists as to the most desirable spot. From his personal experience Dr. A. G. Mayer is prepared to support the claims of Tortugas, Florida. A residence for several years in Jamaica is my excuse for the presentation of what I conceive to be the superior advantages of this island, in which I am supported by two of Dr. Mayer's correspondents, Professors E. G. Conklin and T. H. Morgan.

First with regard to the comparative richness of marine life in the different regions of the West Indies. Investigations of the various groups so far conducted (fishes, crustacea, echinoderms, corals, actinians) reveal a great similarity throughout, as would be expected from the uniformity of temperature and the insular conditions of all the likely places. Hence, as regards abundance of life, any area otherwise suitable would be almost equally desirable, except for specific purposes, for the needs of the marine zoologist alone.

A tropical laboratory is much more likely to be a success if from its position it appeals to the worker on land and fresh-water forms as well as marine, to the botanist as well as to the zoologist. And there is no reason why the center chosen should not be as desirable for the one purpose as the other. It is in this respect, however, that the various islands differ greatly, and where the advantages are altogether in favor of Jamaica. Nowhere in the West Indies is there readily available such a diversity of terrestrial faunal and floral conditions, a fact already recognized by Professors Campbell and MacDougal after an investigation of other islands, and supported by the many American botanists and zoologists visiting there from year to year. The presence of a well-equipped and long-established government botanical department, with all its collecting traditions, is not one of the least of its attractions, as well as known localities for such interesting forms as *Peripatus*. The student concerned with the results of the introduction of new animals and agricultural pests will have his ardor more than satisfied by the mongoose, toad and tick.

In the matter of health the tropics are generally viewed with suspicion. This is well founded as regards investigators who desire to carry on work, involving exposure, in the same manner as in temperate parts, but is of little moment to the resident or experienced visitor aware of the precautions called for under the totally new environment. To select any locality of which the general healthiness or climatic conditions are uncertain, or where proper medical advice and attention are not available, would undoubtedly sooner or later result in a sad collapse.

A central, readily accessible spot, where the general social life and the character of the people will add something to the experience of visitors, is also matter for consideration. The Naples Zoological Station undoubtedly owes some of its success to its geographical position and historic surroundings. A comparatively unknown isolated spot, with no associations beyond those of the laboratory, is not likely to offer sufficient attractions to make a long sea voyage, especially to European colleagues, nor can possibly give that status which a center of activity already recognized can confer. The general social conditions of Jamaica, the hospitality offered from the governor downwards; the experience of English

official, naval and military life are features which have always constituted a charm and attractiveness to the many American biologists who have already experienced them.

Another consideration very important to my mind is the educational value to young biologists—prospective investigators—to be obtained from such an establishment. The broadened conception of the possibilities of the animal and plant world which even a short experience within the tropics affords is very desirable. To wander amid the beauty and luxuriance of life on a coral reef, or pass amongst the intricacies and remarkable adaptations within a tropical forest, gives an inspiration not to be experienced in temperate regions. For this purpose a station having the greatest variety of both land and marine conditions is obviously most desirable. I conceive that many professors will think it worth while to take or send their most promising students, the idea of a general acquaintance with a tropical fauna and flora predominating over that of discovering material for research. For many years such has been the custom of Professor Brooks with regard to his students, and the conditions found in Jamaica have most nearly approached the ideal.

J. E. Duerden.

University of North Carolina.

SHORTER ARTICLES.

THE PHYSICAL BASIS OF COLOR.

At the present time no one, I think, questions the validity of the wave-theory of light. We may hold various views as to the nature, or even the existence, of that omnipresent medium, the ether; and the physicist, though unable to get along without it, is continually changing his conceptions of its manner of action; but the broad general principles upon which the theory is built remain unshaken.

The backbone of the theory is *periodicity*. Innumerable measurements of extreme accuracy have been made whilst experimenting in the various domains of optics, all of which agree in the conclusion that light, in its very essential nature, is *periodic;* and the simplest image one can form in his mind of such a phenomenon is a wave-motion, while the simplest method of representing it mathematically is by the circular functions of the sine and cosine.

The three quantities which determine a wave-motion are its amplitude, its wave-length (and, therefore, its frequency or period), and the form or contour of the waves. The mechanical measure of the intensity is proportional to the square of the first of these, while the sensation of color is in some way indissolubly connected with the second—possibly, also, with the third, though I do not know of any direct evidence on the question.

It has been usual to assert that color is purely a function of the wave-length, just as pitch is a function of wave-length in acoustics. Light of one wave-length would excite one color, light of another wave-length, a different color, etc. In an article on 'Color Saturation,' which appeared in the *American Journal of Psychology* (Vol. VII., No. 3, April, 1896), my friend and colleague, Professor A. Kirschmann, expresses dissent from the view generally accepted (by physicists, at any rate), and it is the question raised by him that I wish to briefly consider.

Dr. Kirschmann remarks: 'It is claimed that light of one certain wave-length causes the impression of red, another that of green, etc.; but this is mere hypothesis, for *nobody has ever seen light of one wave-length.*' Perhaps it would be fairer to state the proposition as I have done in the preceding paragraph. The physicist surely does not claim that he has ever worked with light of absolutely a single wave-length, though we shall see how near he has been able to approach to it. If a writer on the wave-theory should indulge in such superficial dogmatic statements, he must not be taken too literally, and the true value of the theory must not be judged therefrom.

Dr. Kirschmann supposes a 'pure' spectrum, a meter in length, to be produced on a screen, and discusses the nature of a narrow band of this image 1/100 of a millimeter in width. Taking the number of vibrations per second, corresponding to extreme red and extreme violet, to be 412 million million and 790 million million, respectively, we see that

the total change of vibration-frequency as we pass from one end of the spectrum to the other is 378 million million. Now, the width of the band under consideration is 1/100,000 of this distance, and hence in crossing from one side of it to the other there is a change of frequency of approximately 3,780 millions per second. Ordinarily the light from such a narrow band of a 'pure' spectrum would be considered very homogeneous, *i. e.*, of very approximately a single wave-length; but looked at from the point of view of number of vibrations per second, this variation in frequency of 3,780 millions per second, which is to be found amongst the constituents of the light, would at first sight appear so large that we should not be justified in saying that the light from the band is practically of one wave-length. This view is, indeed, held by Dr. Kirschmann, but I hope to show that it is untenable.

Let us look at it in another way. As we pass from the blue to the red end of our spectrum the wave-length increases by an amount equal to itself—by 100 per cent.—this increase being uniform if the spectrum is *normal.* Hence in passing over a band 1/100 of a millimeter in breadth the wave-length increases by 1/100,000 part of itself. Thus in the light which comes from this narrow space there is, if we consider the case in absolute mathematical strictness, a superposition of waves of different lengths, but yet the waves are extremely uniform, since the longest is only 1/100,000 part greater than the shortest. Stated as an absolute length, this difference between the longest and the shortest waves is but one five-thousand-millionth part of an inch.

The size of the number expressing the measure of any quantity depends only on the unit used, and may be quite meaningless when we come to deal with actual sensations. For example, the length of two rods may differ by but the millionth of an inch, a quantity smaller than the error of experiments made to compare them, so that from our physical measurements we should say that the rods were of the same length; and yet if we chose the diameter of a molecule as our unit of length, the infinitesimal difference between the lengths of the rods would be expressed by millions of millions.

In the light under consideration there is strictly a variation in the wave-lengths, but relatively this is an extremely small quantity —too small to be considered as an essential factor in determining the nature of our sensation. Would it be reasonable to suppose that if there were absolutely no variation at all the effect on the eye would be different? Experiments do not indicate that the eye has such marvelous delicacy that it can detect any such infinitesimal changes.

In a pure spectrum a meter long the widths of the colored bands in the most sensitive portion are given by Rood* as follows:

	Normal Spectrum.	Prismatic Spectrum.
Orange-yellow	.26 mm.	20 mm.
Yellow	.13	10
Yellow-green and green-yellow	.97	104

Of course it must be understood that these quantities are not absolutely definite magnitudes. They are simply the careful estimate of an accomplished scientist and artist.

An attempt was made to test the sensitiveness of the eye in the following way: By means of a narrow slit and a direct-vision train of prisms in front of an electric arc lamp, a spectrum 80 centimeters long was thrown on an opaque screen, in which was an opening about a centimeter wide and 3 centimeters long. By shifting the screen, light from any desired portion of the spectral image was allowed to come through, and it was then received on a finely ground glass plate. By means of black paper strips the portion of the ground glass thus illuminated was further restricted to two narrow bright bands approximately 1.5 millimeters in width. When working in the yellow it was found that these bands could be separated by a dark strip 1.5 millimeters wide, and still be indistinguishable from each other. A second observer, experienced in optical work, agreed in the above result. Thus the eye was unable to distinguish between the colored bands whose centers were 3 millimeters apart. Now, this distance

* Rood, 'Modern Chromatics,' p. 24.

is 3/800 or 1/266 of the total length of the spectrum, and hence, in passing over it, the wave-length varies by approximately 1/266 of itself, and yet the eye could detect no difference. This certainly seems to indicate that the minute change of 1/100,000 of the wave-length, above referred to, is not at all able to alter or control the chromatic sensation experienced by the eye. The spectrum used in this experiment was a comparatively pure one, since in the yellow band, one centimeter wide, admitted through the opening in the screen, the bordering colors, orange and green, could clearly be seen at the edges.

But it might be remarked that Dr. Kirschmann's case is a purely hypothetical one, and that my arguments are quite as theoretical, and so it will be interesting to see just how far we have been able to actually go towards obtaining a perfectly monochromatic light.

As is well known, the spectrum given by a grating, with proper adjustments, is normal. The distance between two portions of the spectral image is proportional to the difference of the wave-lengths proper to these portions. Also, the spectrum of a sodium flame (given, for instance, by burning ordinary salt in a Bunsen flame) consists of two bright lines separated by a narrow space. The mean wave-length of the light forming one of these lines is approximately 1/1,000 greater than that forming the other.

When working with a plane reflexion grating, containing 14,400 lines ruled on a space two inches wide, it was observed that the interval between the two sodium lines was about ten times as wide as either line. Now, as we pass across the interval from one line to the other there is a variation of 1/1,000 in the wave-length, and hence in passing from one side to the other of a bright line the change in wave-length is *not greater* than 1/10,000.

But the narrowing of the spectral lines is directly proportional to the total number of rulings on the grating, while the interval between two lines varies directly as the closeness of the rulings; and in some gratings used by Professor Rowland there were as many as 120,000 lines on a space of six inches, *i. e.*, 20,000 to an inch. Here the rulings are eight times as numerous as in the former case, and so the bright lines of the spectrum should be only one eighth as broad; also, the rulings are three times as close, and so the interval between the sodium lines should be increased threefold. Thus a grating like this should give a spectrum in which the interval between the sodium lines is over 200 times the width of either bright line. If such were the case, we could conclude that the wave-length of the light from each sodium line did not vary as much as 1 in 200,000.

Rowland,* however, remarks that there is a limit to the applicability of this line of reasoning, and that the width of a spectral line given by a grating depends not only on the width of the slit and the number of rulings on the grating, but also on the *true physical width* of the line. But it is quite certain that at least one half the high resolving power above referred to was reached by him in his experiments (*i. e.*, that he really obtained a spectrum in which the width of either sodium line was but 1/100 of the interval between them), since he reports having actually photographed some lines in which the variation in wave length was not more than 1/80,000.

But the best test for the homogeneity of any light is to determine what is the greatest difference of path which two portions of it may have and still give interference fringes. With white light this is very small. In the ordinary apparatus for observing Newton's rings only eight or nine rings can be seen with white light, and for the ninth ring the difference of path is about 1/200 of a millimeter, a very minute quantity. If sodium light be used, many more rings can be seen; and indeed interference has been observed † with it with a difference of path of 200,000 waves, or over ten centimeters.

By using the green line ($\lambda = 5461$), obtained on decomposing by a prism the light

* *Philosophical Magazine*, 5 ser., Vol. 16, p. 209. 1883.

† By A. A. Michelson and E. W. Morley. See address before the American Association for the Advancement of Science, Cleveland meeting, 1888, by A. A. Michelson.

emitted by mercury vapor in a vacuum tube made incandescent by the passage of an electric discharge through it, Perot and Fabry* were able to secure interferences with a path-difference of 43 centimeters, which is equal to 790,000 wave-lengths; while Professor Michelson, of Chicago, who is preeminent in this work, and whose interferometer is the instrument generally used in such researches, informs me that he has obtained interferences, with the light from this same mercury line, when there was a path-difference of 840,000 wave-lengths. In this case the variation in wave-length could hardly have been greater than one part in 1,000,000—truly an extraordinarily close approach to perfect uniformity.

Now, in all these experiments there was no sign of the color disappearing as the wave-lengths approached more and more nearly to equality. Indeed, Professor Michelson's observation is that as the light approaches perfect homogeneity the intensity of the color sensation is slightly increased!

Light of a single wave-length in optics corresponds to sound of an absolutely pure tone in acoustics. A well-made tuning-fork is by no means a perfect instrument, and yet it emits a note closely approximating a pure tone; but such a fork is just as efficient in producing the sensation of sound as the most complex mixture of wave-lengths given forth by any instrument.

Is it possible, then, that these little variations in the wave-lengths, and not the wave-lengths themselves, are the essential physical cause of the sensation of color? Surely it would be just as reasonable to believe that, by removing all the impurities from water, or nitric acid, or any other definite chemical compound, these substances would lose the *taste* characteristic of each.

I think it unreasonable, therefore, to contend that for the production of the sensation of color it is necessary to have a superposition of waves of different lengths. It is quite true that two color sensations which are indistinguishable from each other may be produced in different ways—either by light of approximately uniform wave-length or by a combination of quite different wave-lengths. For instance, a mixture of red and green will give an orange which, as a sensation, is indistinguishable from spectral orange. In Maxwell's phrase, they are *chromatically* the same, but *optically* they are different. In such matters the eye is much inferior to the ear, which can, in many instances, resolve a compound sound into its constituents; and it would be hard, indeed, to produce a combination of sounds which would so perfectly simulate a simple tone that one could not distinguish between them when they were heard together.

But I can not see why color-quality should not be considered simply as a function of the wave-length. Dr. Kirschmann says: "It may just as well be—and the probability for this supposition is even greater—that the color-quality is a function of the superposition of wave-lengths, so that to every qualitative difference in spectral colors corresponds a difference in the mode of superposition." I think the facts I have given show conclusively that a spectral color is not at all dependent on any 'mode of superposition.' We need no such idea to define spectral colors, and the introduction of it seems a needless complication.

Let us now briefly consider Dr. Kirschmann's 'inverted spectrum,' and his application of the principle of superposition to explain the true position of purple.

When we view through a prism a dark line of the proper width, on a white background, we see a kind of 'inverted spectrum,' with purple in the middle. With Dr. Kirschmann, 'we must agree that the existence of this color does not prove anything more than that the mixture of the ends of the spectrum gives purple.' That is all the experiment appears to me to prove.

If a narrow bright band be viewed through a prism we get a 'pure' spectrum. As we all know, the term 'pure' here has not a very definite meaning. It signifies that certain optical requirements have been complied with; and if we are using sunlight the familiar test for purity is the presence of the Fraunhofer dark lines. If now the bright slit be gradu-

* *Comptes Rendus*, Vol. 128, p. 1223, 1899.

ally widened the colors rapidly lose their pure hues, the change at the central portion being most marked at first. Finally, if the slit be made wide enough, the color entirely disappears from the middle part, while at one end (accepting Dr. Kirschmann's description) there is a band of red, orange and yellow; at the other, one of blue and blue-green. The explanation of this is well known. A wide slit may be considered as the sum of a great number of narrow ones, each of which gives rise to a pure spectrum, but these spectra are superposed, producing perfect white in the middle and the colors mentioned at the ends.

Dr. Kirschmann explains the absence of green proper by saying that its two neighbors, blue and yellow, are here separated, and so are deprived of the power of cooperation, just as in the ordinary spectrum red and blue are separated, and thus can not produce purple. But the nature of the mixture is very different in the two cases, and even though we should grant that the sensation of green is due to the superposition of blue and yellow, we should hardly be justified in concluding that purple should be considered as simple a color as green, since blue and yellow have wave-lengths nearly equal, while the wave-length of red is approximately twice that of blue. We *know*, from physical considerations, that purple is not simple like spectral green.

From the explanation given above it would appear that the 'inverted spectrum' is far from being a pure one, though Dr. Kirschmann thinks that this statement can be proved unfounded. When we examine with a spectroscope the light reflected from a very thin sheet of mica, we see the spectrum crossed transversely by a number of dark bands. This phenomenon is one of the large interference-family of 'colors of thin plates,' and is ordinarily known as the 'channeled spectrum.' Many investigations have been made on it. Dr. Kirschmann states that he was able to obtain these 'channels' in the 'inverted spectrum.' For the production of such, however, the spectrum need not by any means be pure. In a single experiment with a direct-vision spectroscope and a sheet of mica about 1/100 of a millimeter thick, I was able to see the 'channels' when the slit was 0.6 millimeter wide, while to show the *most prominent* Fraunhofer dark lines, and thus have a slight approach to purity, the slit had to be less than 0.25 millimeter wide.

To use the channeled spectrum for the purpose of measuring wave-lengths, as suggested, is not very convenient, since the thickness of the thin plate, its index of refraction, the angle of incidence (or of refraction), as well as the 'order' of the interference, would all have to be determined. But if *some* wave-lengths are known, *others* may be conveniently located by this means. A very elegant application of this method was made by Maxwell* in his classical experiments on the mixing of spectral colors. His thin plate was a layer of air between two plane plates of glass, and by the channels in the spectral image shown at the end of his color-box he was able to calibrate in wave-lengths an arbitrary scale put across it.

C. A. Chant.

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* *Phil. Trans. of R. S.*, 1860. 'Scientific Papers,' Vol. I., p. 410, § 6.

SURFACE TENSION; MOLECULAR FORCES.

In deducing the surface tension equations by the method of Laplace we start with the assumption that the force with which one element, dv, of the liquid attracts another δ element, v, is

$$F=\frac{1}{k}\rho^2\cdot dv\cdot\delta v\cdot f(r)$$

(usually the k is wrongly omitted), where ρ is the effective density of the liquid, and $f(r)$ is the law of the variation of the force with the distance. Finally we find that the surface tension is

$$T=\frac{1}{k}\rho^2 I,$$

where I is a definite integral (and hence a constant) derived from $f(r)$. In measuring the surface tension of liquids we are usually content to stop when we have found T, or we endeavor to find relations between the values of T for different liquids. We can do much

better than this. The most superficial consideration will show that ρ can not be the ordinary density; but, if what we have designated as molecules have any physical significance whatever, ρ must be proportional to the number of molecules in unit volume. If M is the molecular weight of the liquid, and D is its density, then D/M is the number of gram molecules per unit volume, and we must have

$$\rho = \frac{mD}{M}$$

where m is the factor of proportionality and depends upon the nature of the molecule. Substituting this in the equation for the surface tension we find

$$T = \frac{1}{k}\frac{m^2D^2}{M^2}I$$

or

$$\frac{M^2T}{D^2} = I\frac{m^2}{k},$$

a quantity in which the density, which varies from liquid to liquid in a way which can not be predicted, no longer explicitly enters. This quantity M^2T/D^2 is probably very important in molecular mechanics; if k were the same for all liquids it would be *most* important, as it would give us m, which we may call the *mean molecular moment* of the liquid. k, however, probably varies from liquid to liquid.

So far we have made no assumption other than those contained in Laplace's equations. Now we shall go farther. If molecular forces are electrical in their origin, as Professor Sutherland and others think, then we are almost justified in putting k equal to the specific inductive capacity of the liquid; and if on replacing k by this quantity we arrive at values for the *molecular moment, m,* all of the same order of magnitude, we can say that the assumption is at least not an improbable one. The following table contains the various quantities involved for twenty substances (all of those for which I have the necessary data at hand), and we see that

Liquid.		k	D	M	T	$\frac{M^2T}{D^2} = I\frac{m^2}{k}$	$\left[\frac{kM^2T}{D^2}\right]^{1/2} = \sqrt{I}.m$ *molecular moment.*
Benzene	C_6H_6	2.3	0.88	78	27.5	216×10^3	0.71×10^3
Toluene	C_7H_8	2.3	0.89	92	27.9	299	0.82
Cymene	$C_{10}H_{14}$	2.3	0.87	134	27.9	660	1.22
Methyl alcohol	CH_4O	33.	0.80	32	23.8	38	1.14
Ethyl "	C_2H_6O	26.	0.79	46	23.1	78	1.41
Propyl "	C_3H_8O	23.	0.79	60	24.1	139	1.79
Amyl "	$C_5H_{12}O$	16.	0.83	88	23.8	267	2.06
Acetic acid	$C_2H_4O_2$	9.7	1.05	60	29.0	95	0.96
Butyric "	$C_4H_8O_2$	3.0	0.96	88	27.2	228	0.82
Ethyl formate	$C_3H_6O_2$	9.1	0.95	74	25.8	156	1.18
" acetate	$C_4H_8O_2$	6.5	0.90	88	25.1	239	1.26
" propionate	$C_5H_{10}O_2$	6.0	0.91	102	26.0	328	1.41
" butyrate	$C_6H_{12}O_2$	5.3	0.90	116	25.0	416	1.48
Methyl acetate	$C_3H_6O_2$	7.8	0.96	74	25.3	150	1.08
Ethyl "	$C_4H_8O_2$	6.5	0.90	88	25.1	239	1.26
Propyl "	$C_5H_{10}O_2$	6.3	0.91	102	26.2	330	1.45
Ethyl ether	$C_4H_{10}O$	4.4	0.79	74	18.2	160	0.84
Carbon bisulphide	CS_2	1.81	1.29	76	32.3	150	0.52
Water	H_2O	75.	1.00	18	74.	24	1.34
Sulphur	S_6	2.8	1.98	192	44.6	430	1.13

$$\left[\frac{kM^2T}{D^2}\right]^{\frac{1}{2}} (\equiv \sqrt{I}\cdot m)$$

is of the same order in every case, the greatest (2.0) being four times the smallest (0.5), while T varies from 18 to 74, k from 2 to 75, and M from 18 to 256. This appears to me to be as satisfactory an indication of the correctness of this method of viewing the matter as we should expect.

In dealing with similar compounds, very evident relations exist between the different values of M^2T/D^2 and also of $[kM^2T/D^2]^{1/2}$, but the consideration of these and of other

interesting points will be deferred until I shall have been able to assemble more extensive and newer data.

N. Ernest Dorsey.

Annapolis Junction, Maryland,
January 31, 1903.

THE OVERSPUN STRING.

Loading a string by 'overspinning' with wire, as is well known, causes it to produce a deeper tone without adding to its length. It, also, can be strung over a finger-board, where it may be 'stopped,' thus enabling a single string to produce an octave or more with its chromatic intervals, and to take the place of eight or more long open strings. So far as my information goes, the overspun string was introduced into France by St. Colombe about 1675. The chitarrone with its very long open bass strings dates from 1589 and was used in orchestras in 1607. I am desirous of ascertaining whether the superiority of the overspun string over the long open string for the deeper tones was known earlier than I have mentioned, and whether the chitarrone was used because the overspinning was unknown.

E. H. Hawley.

U. S. National Museum.

NOTES ON THE JUDITH RIVER GROUP.

In August, 1876, Mr. J. C. Isaac (who had been my assistant earlier in the season in the chalk of Kansas) and myself joined Professor E. D. Cope at Omaha, to go with him as his assistants to the Judith River region in Montana. From Franklin, Idaho, we made the journey of 600 miles to Fort Benton by stage. Here the professor purchased a wagon, four work horses and three saddle ponies, employed a cook (to act also as teamster) and a scout, who was to warn us of danger from Indians. Sitting Bull with his thousands of braves was south of our field, fighting the soldiers. We traveled down the Missouri River opposite Clagett, an Indian trading post, 120 miles below Fort Benton. Here we crossed the river, and went into camp on Dog Creek, a few miles east of the Judith River, and about ten miles from its mouth. The cañon of this creek was narrow. We were shut in by the dark and desolate Bad-lands, which, as I remember, the professor estimated as over 1,000 feet high. The lower slopes were composed of beds of lignite, from a few inches to six feet in thickness, and black shale, the lignite layers not appearing in the great bed of shale in its upper part. Professor Cope made a sketch of the wonderful panorama, which I afterwards saw published. The shale disintegrated into dust on the surface, into which one sank to his knees in climbing some steep ascent. This formation, Cope assured me, belonged to the Fort Pierre group of the Cretaceous. We found many bones in it, of mosasaurs and fishes, similar to those I had already collected in western Kansas. After my return from Montana I felt sure the black shales then called Niobrara belonged to the Fort Pierre, on account of their faunal and stratigraphical resemblances to those on Dog Creek. It was years, however, before this view was generally accepted. I remember one very good quadrate I picked up on Dog Creek which I thought belonged to a *Platecarpus.* We could have made large collections of these fishes and mosasaurs but for the fact they were poorly preserved and interfered with the main object of the expedition.

On top of the Pierre deposits, which were the thickest, were the buff-colored sandstones of the Fox Hills group. We found no fossils in it, but I was assured by Cope of their position in the series. The Judith River beds, or Cretaceous No. 6, as Cope identified them, were above the Fox Hills. The rocks of this formation were composed of sandstone and clay. On the very highest summits of the Bad-lands was a thin bed of oyster shells. We remained in our camp over a month here. Every morning at sunrise we were in the saddle, taking a lunch of crackers and bacon. We returned late in the evening. Our chief discoveries were from a yellowish sandstone, in which we found many bone-beds, where loose teeth, bones and fragments of turtle shells were mingled together, often weathered out, lying loose on the surface. I have been deeply interested in reading Professor H. F. Osborn's and Mr. L. M. Lambe's 'Contributions to Canadian Paleontology,' Vol. III.,

Part II., Ottawa, 1902. I was especially surprised to see by the table of the distribution of land and fresh-water Cretaceous vertebrates of the west, that many of the species we procured in these bone-beds on Dog Creek, some of which Professor Cope named on the spot, as I distinctly remember, are placed in the Montana column, which on page 9 is placed below the Pierre. I was the original discoverer of the fish *Myledaphus bipartitus* Cope. As I remember, he gave the specific name from the fact that the enamel on one side of the tooth was dark and light-colored on the other. With this species were hundreds of teeth of *Diclonius, Dysganus, Paleoscincus, Aublysodon,* numberless fragments of the beautifully sculptured shells of the turtles *Trionyx* and *Compsemys,* bones of *Campsosaurus,* scales of *Lepidotus,* etc. In the list referred to I am astonished to find the genera *Diclonius* and *Dysganus* not represented in the Judith River column. If I mistake not I discovered the species of *Dysganus* he named in honor of the Peigan Indians on the spot. The four species certainly belong to the Judith River group. These remarks also apply to the three species of *Diclonius*. The new species of *Monoclonius* do not appear in the Judith River column. As they were discovered near Cow Island forty miles below Dog Creek, I will speak of them later. The facts I have here mentioned can readily be substantiated, if collectors will work over the summit of the Bad-lands, east of Dog Creek, as we found inexhaustible deposits of the genera mentioned above, excepting *Monoclonius,* of course all mingled together. As we were unable to discover any good specimens of complete skulls or bones in this region, Professor Cope took his guide and started on an exploring trip down the river. A few days later he sent word to us by his scout to move camp to Cow Island. The astonishing feat we accomplished, of getting our outfit on top of the Bad-lands, over slopes so steep that we had been obliged on horseback to make long angles in order to make the ascents. After fourteen hours of the most strenuous effort human nature is capable of we got to the level prairie. In one place our four-horse wagon with team attached made three complete somersaults and landed on a ledge of sandstone right side up. The next day, while traveling along between the foothills of the Judith River Mountains, we saw in the distance a horseman approaching, whom we soon recognized as the professor. Before he reached us the scout came out from behind some hill to our south and intercepted him. An exciting conversation took place, judging from their gestures. The scout was the first to come to the wagon. Without a word he took his personal outfit and started toward Fort Benton. The cook followed him until out of our hearing, when they had an earnest talk. On his return to us he shouldered his blankets and grip, starting for a wood camp on the river, after a talk with Cope. We were never told the cause of these desertions, but learned afterwards that the scout had run across Sitting Bull's command in the Dry Fork of the Missouri, not many miles from where we proposed to make our next camp, and being unable to induce the professor to give up his expedition, left us alone in an unknown country. With double labor to perform, we pressed on and made our camp on the river a few miles below Cow Island, on the opposite side at some old steamboat snubbing-posts. We made no other while Cope was with us. He took passage down the river about October 15. I find by consulting the following letter that Professor Cope had become confused in regard to the localities of the four specimens we found near Cow Island of the genus *Monoclonius:*

PHILADELPHIA, *Dec. 21st, 1889.*

Dear Mr. Sternberg:

I am going over the fossils you and Mr. Isaac collected on the N. side of the Missouri River in 1876. I send you a paper showing how far I have got along with the study. I want to ask you some questions. 1st, Did you get the *Monoclonius* you marked, at exactly the same spot as where I dug up (with your help) the bones of the animal I so named? If not, how far off did you get them? I refer especially to the animals figured on Pl. XXIII., figs. 2 and 2*a*.

2nd. Isaac got a lot of bones somewhere in the same neighborhool, I think further west. How far off was that? There are four separate animals, all supposed to come from the place where

I got *Monoclonius crassus;* two of these I got. Both are *M. crassus.* Two you got, one larger (*M. spenocerus*) and one smaller (*M. fissus*) than mine. It is about these latter that I want information. Marsh has been duplicating this work in his usual shameless style. According to him, nothing has been done in this field before. He made a good beginning by describing the horns of one of these fellows as a new species of bison. Answer soon. Very truly,

E. D. Cope.

I remember distinctly helping the professor collect his type specimen. It was on the south side of the river, between our camp and Cow Island. The specimens I collected and those of Mr. Isaac were near together, on the north side of the river, about five miles below Cow Island Station. To my knowledge, Cope never collected on this side. He took passage on a steamboat the day after we crossed, about October 15. Mr. Isaac and myself made a camp about three miles below the station afterwards, and the material referred to was found some distance below our camp. These thick deposits Cope called Cretaceous No. 6, or Judith River group. So I was surprised to find none of the species of *Monoclonius* in the Judith River column. The fish *Hedronchus,* named in my honor, came, I am sure, from the bone-beds in the Dog Creek region. To help solve the problem of the age of these beds it seems to me one way would be to put the Dog Creek fossils in their proper place in the column, and not confuse them with the *Monoclonius* material that was only found by us near Cow Island. If the type localities are systematically studied and the stratigraphical characters fully understood, proof may be forthcoming that the *Monoclonius* beds are older than the Judith River. They are certainly forty miles further down the Missouri than the unmistakable Judith River beds that rest on the Fort Pierre and Fox Hills at Dog Creek.

Charles H. Sternberg.

SEEDS BURIED IN THE SOIL.

Numerous cases are on record in which seeds are said to have remained dormant in the soil for some considerable time, varying from a few years to many centuries. Such reports have always been and will continue to be of much popular interest because many of these seeds, when taken, by chance, from their accidental burying ground and exposed to conditions favorable for germination, have, in many instances, indicated a remarkable prolongation of vitality. It must, however, be remembered that such reports are based chiefly on accidental results, in most cases being even highly speculative, and are, therefore, of but little value in furnishing reliable data as to the length of time seeds will retain their vitality when buried in the soil.

The time required for the completion of such experiments must necessarily extend over a number of years, and for this reason but very few actual experiments have been made. The most important are those of Dr. Beal, as reported in the *Michigan Farmer,* November 30, 1901, in which he found that seeds of twelve out of twenty-one species responded to germination tests after having been buried for twenty years.

In so much as the question is continually being asked, 'How long can seeds remain buried in the soil and still retain their power of germination?' we have started a series of experiments in connection with our work in the Seed Laboratory of the U. S. Department of Agriculture, with the hope of securing some definite data and thereby answering this question once for all. For these experiments we have taken 112 different samples of seed, representing 109 species, 84 genera and 34 families. These have been so selected as to include seeds of most of our common field and garden plants, as well as seeds of many of the grasses and our most noxious weeds. These seeds were first carefully counted, of most samples 200 seeds being taken; however, only 100 of some of the larger seeds such as beans, peas, corn, etc. The seeds were all of the harvest of 1902, save two of the duplicate samples of red clover.

Preparatory to burial the previously counted samples of seed were mixed with dry clay soil and packed in well-baked, porous clay pots of four, three and two inches diameter, depending on the size of the seeds; inverted clay saucers serving as covers for the various pots.

These pots were buried December, 1902, on the Arlington farm of the United States Department of Agriculture, in a heavy clay soil at three different depths. Eight complete sets are covered to a depth of six or eight inches, such as would take place in deep ploughing. Twelve complete sets are buried at a depth of twenty inches, where they will be comparatively free from the action of frost. Twelve more complete sets are buried from three to three and one half feet, thus insuring fairly uniform conditions as to temperature, moisture, etc.

In all 32 complete sets or 3,584 pots have been buried. It is proposed to take up one of each of these sets from time to time and test for germination. The present plan is to make the tests at the end of one, two, three, five, seven, ten, fifteen, twenty, twenty-five, thirty, forty and fifty years. With this scheme the last set of those buried at a depth of six to eight inches will be taken up for test after the lapse of twenty years, and, indeed, it is quite probable that most of this series will have germinated or decayed long before this; in fact we feel reasonably sure that many will succumb during the first year. Similar results will undoubtedly be had from those buried at greater depths, though here vitality will be retained longer. Many, of course, will live for a number of years; on the other hand, it will be quite surprising if any respond to germination tests at the end of fifty years.

J. W. T. DUVEL,
Assistant in Seed Laboratory, U. S. Department of Agriculture.

SOME NEW GENERIC NAMES OF MAMMALS.

IN preparing an index of the genera of mammals, a number of names have come to light which have been previously used for other groups. Some of these names are in current use and apparently have no synonyms which can be substituted for them. The following new names are therefore proposed:

Eosaccomys—new name for *Saccostomus* Peters, 1846, which is preoccupied by *Saccostoma* Fitzinger, 1843, a genus of reptiles.

Eucervaria—new name for *Cervaria* Gray, 1867, which is preoccupied by *Cervaria* Walker, 1866, a genus of Lepidoptera.

Helicotragus—new name for *Helicophora* Weithofer, 1889, which is preoccupied by *Helicophora* Gray, 1842, a genus of Mollusca.

Lophocebus—new name for *Semnocebus* Gray, 1870, which is preoccupied by *Semnocebus* Lesson, 1840, a genus of lemurs.

Morenella—new name for *Morenia* Ameghino, 1886, which is preoccupied by *Morenia* Gray, 1870, a genus of chelonians.

Nannospalax—new name for *Microspalax* Nehring, 1898, which is preoccupied by *Microspalax* Trouessart, 1885, a genus of Arachnida.

Necronycteris—new name for *Necromantis* Weithofer, 1887, which is preoccupied by *Necromantes* Gistel, 1848, a genus of Mollusca.

Neocothurus—new name for *Cothurus* Palmer, 1899, which is preoccupied by *Cothurus* Champion, 1891, a genus of Coleoptera.

Octodontomys—new name for *Neoctodon* Thomas, 1902, which is preoccupied by *Neoctodon* Bedel, 1892, a genus of Coleoptera.

Tapirella—new name for *Elasmognathus* Gill, 1865, which is preoccupied by *Elasmognathus* Fieber, 1844, a genus of Hemiptera.

Tytthoconus—new name for *Microconodon* Osborn, 1886, which is preoccupied by *Microconodus* Traquair, 1877, a genus of Pisces.

T. S. PALMER.
U. S. DEPARTMENT OF AGRICULTURE.

MUSEUM NOTES.

THE *Annual Report* of the director of the Carnegie Museum shows good progress in various directions, but particularly in the line of paleontology, where valuable additions have been made in the shape of specimens of the larger dinosaurs and of Oligocene mammals. Important additions have been made to the entomological collections, which are now among the most important in the United States, and there has been obtained by purchase the only specimen of the almost extinct *Rhinoceros simus* in this country. Pending the important additions to the museum building which are to be made the director pro-

poses to meet immediate wants by the erection of a laboratory building in which the work of preparing and mounting material for exhibition can be carried on.

The report on the 'Prize Essay Contest' for 1901 shows that this is an effectual method for attracting the public school children to the museum.

Accompanying the report of the director is a handsomely printed pamphlet giving an account of the seventh annual celebration of Founder's Day and containing the addresses delivered on that occasion by Whitelaw Reid, R. W. Gilder and Joseph Jefferson.

It may be added that parts three and four, completing the first volume of the *Annals of the Carnegie Museum,* have just been issued.

The *Annual Report* of the director of the Field Columbian Museum for 1901–1902 notes at the outset that the building has about reached the limits of repair. It is to be hoped that an arrangement may soon be made by which the large and valuable collections of this institution may be properly housed. The museum did much field work during the past year, resulting in important accessions to the divisions of anthropology, zoology and paleontology. The attendance has increased and the series of excellent lectures were well attended, both these facts marking a growing interest of the public in the museum.

From a comparison of reports it would seem that museum lectures are vastly better attended in the United States than in Great Britain, but the lavish use of lantern slides here doubtless accounts for a part of the difference. Like the Carnegie Museum, the Field Columbian Museum makes a direct effort to attract the pupils of the public schools, and with equal success.

Of particular interest are the descriptions, with illustrations, showing methods of installation of corals, paleontological specimens and economic collections in the department of botany. It is something of a question if the new cases are not a little too severely simple in their design, for while the prime object of a case is to protect its contents, a case is unavoidably a feature of the hall containing it. It would, therefore, seem to call for some architectural treatment, and the total abolition of cornice and sash moldings gives a case too much the appearance of a mere box.

Besides the illustrations referred to there is a plate of a group of zebras, and views of the groups recently completed by Mr. Akeley, showing the Virginia deer in spring, summer, autumn and winter. These have been in preparation for a long time past, and are unquestionably the most elaborate of the kind anywhere, and the most successful of attempts to imitate nature in museums. F. A. L.

THE AMERICAN MUSEUM OF NATURAL HISTORY.

The 'Thirty-Fourth Annual Report' (that for 1902) of the American Museum of Natural History was placed in the hands of the officers of the Park Department on May 1. It includes, besides the president's report, the financial statement for the year, the list of accessions, and lists of the members, fellows and patrons of the museum.

A summary of the president's report is as follows:

The timely increase on the part of the city of its annual appropriation for maintenance (from \$135,000 to \$160,000) enabled the museum to complete its year's work without calling upon the trustees for additional funds. The city also appropriated \$200,000 for a power and heating station.

Heretofore it has been necessary to borrow money at the beginning of each year to pay the current expenses for maintenance, pending the refunding of such sums by the city, but at the last annual meeting of the board of trustees one of its members very generously gave \$15,000 to be used as a capital to meet the current bills, pending their repayment by the city, the only condition of the gift being that the treasurer's report should show a credit balance of \$15,000 at the close of each year. The terms of the gift have been fully complied with.

At the annual meeting of the board of

trustees held in January, 1902, expenses from the general and maintenance funds were authorized to the aggregate amount of $210,260, involving a deficit of $19,560. The report of the treasurer shows that the museum has not drawn upon this deficit. The invested funds, however, have not been materially increased, and in the absence of any large income the museum is obliged to depend upon the liberality of friends for the development of its collections.

The financial transactions of the museum are now divided into three separate accounts: (1) City maintenance account, covering the receipts and disbursements of moneys received from the city; (2) general account, including the receipts and disbursements of the income from invested funds, membership and admission fees, state superintendent of public instruction, and contributions (not for specific purposes) from the trustees and others; (3) endowment and investment account, including the receipts, investments and disbursements of moneys received from bequests, and contributions for specific purposes. The sums received from bequests and the interest thereon are invested in securities for the permanent endowment. Special funds are kept apart.

The membership of the museum increased during the year. The field parties covered a large territory, and the museum acknowledges the aid rendered by the various railroad companies in lessening the cost of transportation of the men and of the material collected.

The large attendance at the museum by the public and by teachers with their classes, and the attendance upon lectures given at the museum, were gratifying. Several scientific societies held their regular meetings in the museum building. In October, 1902, the International Congress of Americanists held its thirteenth annual session at the museum, and there were present delegates from many foreign countries. The subjects discussed related to the native races of America and the history of the early contact between America and the old world.

Certain facts connected with the work in the several departments of the museum are mentioned.

Dr. Hovey, of the geological department, was sent by the museum on an expedition to Martinique and St. Vincent in May, 1902, and his treatment of volcanic phenomena in general and of the eruptions of Mt. Pelé in particular has received favorable comment throughout the scientific press.

The additions to the museum collection of mammals were unusually large.

The gift from the Peary Arctic Club of about one hundred mammals, collected by Commander Peary on his last arctic expedition, is especially noteworthy, and the museum is now doubtless by far the richest in the world in mammals from arctic America. Donations of specimens in the flesh were received from the New York Zoological Society and the Central Park Menagerie. The Andrew J. Stone Expedition continued its work of making collections of mammals of the Alaskan peninsula.

Material was collected in the Bahamas and Virginia for special bird groups.

In the department of vertebrate paleontology, the collections were enriched by expeditions maintained in the field, and the establishment of a fund by a member of the board of trustees for providing material to illustrate the origin and development of the horse produced immediate results of the highest importance. The purchase of the Cope collections was effected. These include fossil reptiles, amphibians and fishes, and the Pampean collection of fossil mammals from South America.

During the year a number of archeological collections not before exhibited were installed, notably the Hyde collections from the ancient cliff-houses, burial-caves and ruined pueblos of Colorado, Utah and New Mexico. Among the new exhibits installed during the year is the special exhibit of a portion of the material obtained during the researches in the Delaware valley, which have been carried on for over twenty years. It seems to show that man was in the valley of the Delaware at the

time that certain of the glacial deposits and those immediately following were made.

An exceptionally large amount of ethnological material was installed. Early in the year, the Chinese collections were placed on temporary exhibition, and in the spring work was begun on the installation of the Siberian collections of the Jesup North Pacific Expedition.

The work of the Jesup North Pacific Expedition progressed satisfactorily. The aim of the expedition to collect full information of all the tribes of the North Pacific coast has in the main been accomplished. The whole district from Columbia River in America westward to the Lena in Siberia, has been covered fairly exhaustively, and it is already evident that the relationship between Asia and America is much closer than has hitherto been supposed.

The Huntington California Expedition and the North American Research were continued, and much information gained in regard to certain of the native tribes of America.

The East Asiatic work of the Expedition to China promises important scientific results.

The Hyde Expedition carried on work in the southwest and in northern Mexico during the year.

The results of the work of the Mexican Expedition throw much light on the burial customs of the ancient Zapotecans, and the collections obtained add materially to the importance of the collection in the museum. Rare specimens of gold, copper and jadeite secured by the expedition, added to those already in the museum, make this part of the Mexican collections the best in any museum. From the Duke of Loubat, the museum received a gem collection of great importance from the state of Oaxaca.

Local explorations were carried on in the Shinnecock and Poosepatuck reservations on Long Island and Staten Island and at Shinnecock Hills.

Several additions were made during the year to the gem collection in the department of mineralogy, namely, five magnificent crusts of amethyst, a large yellow sapphire, two parti-colored sapphires, an immense star sapphire and a curious archaic axe of agate, gifts of Mr. J. Pierpont Morgan. A splended collection of gold and silver coins from the Philadelphia Mint, the gift of Mr. Morgan, was placed in the gem room.

The department of invertebrate zoology received an important accession in a collection of West Indian corals, actinians and alcyonarians collected in Jamaica.

The New York Zoological Society and the Department of Parks were the principal donors of reptiles and batrachians.

In the department of entomology, the Hoffman collection of butterflies was transferred to the new cases, and the Schauss collection of moths provisionally arranged. From the Black Mountains of North Carolina, 7,000 specimens were obtained for this department.

The publication of the scientific results attending the investigations of the museum progressed during the year.

Several courses of lectures were offered, under various auspices: To teachers, to members of the museum and to the public (holiday course), under a grant from the state; to teachers, by the museum in cooperation with the Audubon and Linnæan societies; to the public, by the city department of education in cooperation with the museum.

The president sums up his report in the following words: "In concluding this my twenty-second report, I take pleasure in assuring the members of this board that the past year has been one of achievement. The increase in the annual appropriation, the growing popularity of the lectures, the large sums spent for laboratory research, the long list of publications, the opening of new exhibition halls, the appropriation by the city of $200,000 for a new power house, the receipt of large invoices of ethnological material from Siberia and China, the conclusion of negotiations leading to the purchase of the Cope collection, and the departure of several exploring expeditions, are only a few of the indices of activity at the museum, of the generosity of our friends, and of appreciation on the part of the city officers and the visiting public."

SCIENTIFIC NOTES AND NEWS.

DR. EUGENE HODENPYL, of New York, has been elected president and Dr. Simon Flexner vice-president of the American Association of Pathologists and Bacteriologists.

DR. A. C. ABBOTT, professor of hygiene at the University of Pennsylvania, has been appointed chief of the Bureau of Health at Philadelphia.

THE freedom of the city of Rome was conferred on Mr. G. Marconi on May 7.

THE Stockholm Society of Anthropology and Geography has awarded its Vega medal to Professor von Richthofen, of Berlin.

DR. M. NÖTHER, professor of mathematics at Erlangen, has been elected a corresponding member of the Paris Academy of Sciences.

CAMBRIDGE UNIVERSITY has conferred the degree of D.Sc. on Dr. Robert Bell, F.R.S., acting director of the Geological Survey of Canada.

DR. FLORIAN CAJORI, professor of mathematics at Colorado College, has been appointed representative of the United States on the international committee of the Congress for the Study of the History of the Sciences, which committee will make arrangements for the next meeting of the Congress at Berlin in 1906. Officers of the committee are: President, P. Tannery, Paris; Secretaries, P. Giacosa and G. Loria, Genoa.

PROFESSOR C. V. HARTMAN, the well-known archeologist, whose work upon the antiquities of Costa Rica was recently published by the Royal Geographical Society of Sweden, and who several months ago accepted service in the Carnegie Museum as the curator of archeology and ethnology, is at present in Costa Rica in the interest of the museum. The Carnegie Museum has secured by purchase from Senor Don Pedro Maria Velasco the extensive collection of Costa Rican Antiquities at present on deposit in the Archeological Museum of the University of Pennsylvania. Dr. W. J. Holland, the director of the Carnegie Museum, announces that it is not his intention, however, to remove the collection from the temporary custodianship of the museum in Philadelphia, until a later date.

SECRETARY CORTELYOU, of the Department of Commerce and Labor, has appointed a commission to take under consideration all the statistical work of the bureaus included in his department for the purpose of recommending any changes that can be made for improving this branch of the service. The commission consists of Mr. Carroll D. Wright, commissioner of labor, chairman; Mr. S. N. D. North, of the Census Bureau, vice-chairman; Mr. Frank H. Hitchcock, chief clerk, Department of Commerce, secretary; Mr. James R. Garfield, commissioner of corporations; Mr. O. H. Tittmann, superintendent Coast and Geodetic Survey; Mr. George M. Bowers, commissioner of fish and fisheries; Mr. F. P. Sargent, commissioner-general of immigration, and Mr. O. P. Austin, chief of the Bureau of Statistics.

THE New York *Evening Post* says that Professor L. M. Hoskins, of the civil engineering department of Stanford University, has been appointed by the Carnegie Institution a member of the committee of investigation to conduct a joint inquiry into mathematical, astronomical, physical, chemical and geological phases of the earth and problems that lie in the common domain of these sciences.

PROFESSOR ISRAEL C. RUSSELL, of the department of geology in the University of Michigan, will make an extended journey in central Oregon during the coming summer, for the purpose of studying the geology and especially the artesian conditions. The work is to be done for the United States Geological Survey, and is in continuance of explorations in the arid portion of the West, in which Professor Russell has been engaged for several years.

DR. GEORGE C. MARTIN, assistant in paleontology at Johns Hopkins University, is in charge of an expedition, sent out by the U. S. Geological Survey to study coal and oil resources of the Cook's Inlet region in Alaska.

DR. THIELE has been made a curator in the Zoological Museum at Berlin.

Professor H. M. Hurd, of the Johns Hopkins University, will give the address before the Medical School of Yale University at the approaching commencement, his subject being 'The Duty and Responsibility of the University in Medical Education.'

The Croonian lectures before the Royal College of Physicians of London will be delivered by Dr. C. E. Beevor on June 9, 11, 16 and 18. The subject will be muscular movements and their representation in the central nervous system. The first course of FitzPatrick lectures founded by Mrs. FitzPatrick in memory of her late husband, Dr. Thomas FitzPatrick, will be delivered by Dr. J. F. Payne on June 23 and 25. He has chosen for his subject English Medicine in the Anglo-Saxon and Anglo-Norman Periods.

Dr. W. M. Bayliss, assistant professor of physiology at University College, London, is bringing an action for libel and slander against the Hon. Stephen Coleridge, on the ground of certain statements made in a speech on May 1, at the annual meeting of the National Antivivisection Society.

Professor J. H. Gore, of the Columbian University, has accepted the position of commissioner general for the Siamese government at the St. Louis Exposition. The Siamese government will erect on the grounds a reproduction of one of the most striking buildings of Siam.

An expedition in charge of Dr. F. A. Cook, of Brooklyn, is to explore Mount McKinley and other Alaskan mountains under the auspices of the Geographical Society of Philadelphia and the Arctic Club, of New York.

Professor Jacob Reighard, of the University of Michigan, has been granted leave of absence for the last eight weeks of the academic year in order that he may investigate the habits and methods of artificial propagation of the black bass. A laboratory has been fitted up at the state bass hatchery at Mill Creek in Kent County, where Professor Reighard is working under the auspices of the Michigan Fish Commission.

The British Institution of Civil Engineers has presented to the Italian government a bust of George Stevenson to be placed in the railway station at Rome.

A committee, consisting of Professors W. K. Brooks, W. H. Howell, W. T. Sedgwick, E. A. Andrews and Theodore Hough, has arranged for a portrait of the late Professor H. Newell Martin, for many years professor of physiology in the Johns Hopkins University. It is to be a Copley print, a sepia-tone platinotype 14 x 11 inches, made by Messrs. Curtis and Cameron, of Boston. The cost of the picture is $5, and it may be obtained from Dr. Theodore Hough, Massachusetts Institute of Technology, Boston, Mass.

The death is announced of Mr. Clarence Bartlett, who recently retired from the post of superintendent of the London Zoological Gardens; of M. Worms de Romilly, the French physicist, and of Professor Wigburgh, of the School of Mines of Stockholm.

The first *conversazione* of the Royal Society was held on the evening of Friday, May 15, at Burlington House.

A geographical society has been founded at St. Petersburg in connection with the university, with Professor Brunov as president.

The International Association of Botanists has held its first congress at Leyden under the presidency of Professor Goebel, of Munich.

Mr. H. L. Florence has given £1,000 to the Cancer Research Fund, London.

The Canadian government has declined to make further contribution to the Marconi system of trans-Atlantic telegraphy, the minister of finance stating in the House of Commons that it had not been as successful as expected.

A uniform time, based on the 30th meridian, or two hours east of Greenwich, has been adopted by all the South African governments, with the exception of German Southwest Africa.

The Gulf Biologic Station, established by the state of Louisiana at the mouth of the Calcasieu River in Cameron Parish (county), will be opened on July 1, 1903. A large laboratory building has been erected and all necessary equipment for investigation of

marine life has been provided. Board may be procured near the laboratory for $18.00 per month. Collectors and investigators are especially invited. For further particulars apply to Professor H. A. Morgan, Louisiana State University, Baton Rouge, La.

WE learn from the *Geographical Journal* that an association for the advancement of scientific research in the Adriatic has been founded in Vienna. At the inaugural meeting, which was held in the university on March 24, the proceedings were opened by the Rector of the University of Vienna, Hofrath Gussenbauer, and after a speech by the president of the new association, Count Vetter von der Lilie, Professor Berthold Hatschek delivered an address on 'Marine Research.' The work of the association, which will cooperate with the Government biological station at Trieste, will in the first instance consist in establishing and maintaining a marine aquarium at Trieste, and in fitting out a suitable steam-vessel for the scientific exploration of the northern part of the Adriatic.

THE London *Times* states that a report has been received by the Liverpool School of Tropical Medicine from the Senegambia expedition. Dr. Dutton and Dr. Todd, writing from McCarthy Island in the Gambia, state definitely that trypanosomiasis is prevalent over the whole of the British colony of the Gambia. They have now completed the examination of over 1,000 natives. They have also discovered that trypanosomiasis is extremely common among all the horses there, and is chiefly responsible for the great mortality in those animals. Dr. Dutton and Dr. Todd have now left the Gambia to continue their researches into the disease in the French Senegal settlement, which adjoins that of the British.

FOREIGN journals state that the Viceroy of India will devote the donation of £20,000 from Mr. Henry Phipps to two objects, a laboratory for agricultural research, to be called the Phipps Laboratory, which will probably be situated at Dehra Dun, and the provision of a second Pasteur institute in the south of India similar to that at Kasauli. The donation will be devoted to the requisite buildings, while the site will in both cases be provided by government, which will also in the first case contribute to and in the second undertake the cost of maintaining the institution.

SIR J. WOLFE BARRY, chairman of the engineering standards committee, writes to the London *Times*, pointing out that the lists of rolled sections recently issued deal only with the sections used in ships, bridges, general building construction and underframes of railway rolling stock. These cover but a small portion of the work which is being carried out by the committee. In addition to the above subjects, the following subcommittees are at work on equally important matters and will shortly report to the main committee. (1) Three committees on rails and tires engaged in drawing up a series of standard railway and tramway rails for use in this country and the colonies. (2) Four committees on the standardization of locomotives, which question, in so far as it relates to Indian locomotives, has been officially referred to the Engineering Standards Committee by the government of India. (3) Four committees on the question of the standardization of electrical plant. The standardization of pipe flanges will also before long be taken in hand, in cooperation with the Institution of Mechanical Engineers. Another sphere of the committee's operations (only as yet commenced) will be the issuing of standard specifications and standard tests for materials.

WE learn from the *Geographical Journal* that at its annual meeting, the Russian Geographical Society awarded its Constantine gold medal to P. K. Kozloff for his last researches and geodetical measurements in Tibet, his excellent maps, and most valuable zoological and botanical collections. The Count Lütke medal was awarded to N. M. Knipovich, for his researches in the Arctic Ocean, and to N. A. Sokoloff, for his geological and geographical work. The large gold medals of the section of ethnography were awarded to Professor V. A. Zhukovsky, for

his work on folk-lore in Persia, and to V. N. Perets, for ethnographical work. The Semenoff medal was given to L. I. Brodovsky, for the map of Manchuria which he has compiled. Small gold medals were given to A. K. Kuznetsoff, for the work he has done in the museum of the Chita (Transbaikalian) section of the Geographical Society; to V. H. Ladyghin, for his work during the Kozloff Tibet expedition; and to L. S. Berg, for his exploration of Lake Aral. A number of silver medals for various minor works were given to several persons. The greatest achievement of the Geographical Society was the visit to Lhasa by a member of the society, the Buryat Lama, M. Tsybikoff, who has also been at a number of monasteries in Tibet, and has brought back 319 volumes of various works of Buddhist philosophy, medicine, history, and so on.

UNIVERSITY AND EDUCATIONAL NEWS.

Professor Hugo Münsterberg announces that the sum of $150,000 for the Emerson Hall of Philosophy, Harvard University, has been secured.

The University of California has received from Mr. W. M. Pierson a telescope with an eight-inch lens, and from Mrs. A. S. Halliday $500 for the library of mechanical engineering.

The trustees of Columbia University have appropriated $8,000 for the erection of two buildings at Morris, near Litchfield, Conn., to be used as dormitories for the summer school of surveying.

Announcement is made of the establishment of four Yale scholarships by Chicago Yale alumni, who give $2,500 a year for deserving and needy Illinois students to be chosen by the faculty in the academic department and scientific school.

Governor Odell has vetoed the item appropriating $10,000 for supporting the School of Forestry at Cornell University.

The summer session of the University of Maine will open June 29, and continue for five weeks. For this summer term courses are offered in physics, chemistry, botany, mathematics, astronomy, history, English, modern languages, Latin and Greek.

James Harkness, A.M. (Cambridge and London), since 1888 professor of mathematics at Bryn Mawr College, has been appointed by the board of governors Redpath Professor of Mathematics at McGill University; and H. M. Tory, M.A., D.Sc., has been appointed associate professor.

Dr. J. Rollin Slonaker, associate in neurology, University of Chicago, has accepted the position of assistant professor of physiology in Leland Stanford Jr. University.

Dr. Theodore Hough, of the Massachusetts Institute of Technology, has been appointed assistant professor of biology at Simmons College, Boston.

G. W. Stewart, instructor in physics at Cornell University, has been elected professor of physics in the University of North Dakota.

Dr. G. W. Whitney has been appointed reader in philosophy at Bryn Mawr College.

Appointments at the New Mexico School of Mines have been made as follows: Royal P. Jervis, M.E., professor of mining; Rufus M. Bagg, A.B. (Amherst), Ph.D. (Johns Hopkins), professor of mineralogy and petrology; Gay M. Hamilton, of the University of Nebraska, instructor in geology. Professor C. L. Herrick, formerly president of the University of New Mexico, and the Hon. Daniel H. McMillan, judge of the U. S. District Court, will give courses of lectures, respectively, on geological philosophy and mining law.

At the University of Birmingham Miss Helen P. Wodehouse, fellow of Girton College, Cambridge, has been elected assistant lecturer in philosophy.

In consequence of ill-health Professor G. V. Poore, M.D., has found it necessary to resign his chair of medicine and clinical medicine in University College, London, and his physicianship to University College Hospital. The council, in accepting the resignation, unanimously adopted a resolution testifying to their high appreciation of the services Dr. Poore had rendered to the college and hospital during the past thirty-five years.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 5, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION I, SOCIAL AND ECONOMIC SCIENCE. I.

AT a business meeting held on Monday morning, December 29, the organization of Section I for the Washington meeting was perfected with the following officers:

Vice-President—H. T. Newcomb, Philadelphia.
Secretary—Frank H. Hitchcock, Washington.
Member of Council—Marcus Benjamin.
Sectional Committee—Carroll D. Wright, Vice-President, 1902; Frank R. Rutter, Secretary, 1902; H. T. Newcomb, Vice-President, 1903; Frank H. Hitchcock, Secretary, 1903; Frank R. Rutter, for five years; B. E. Fernow, for four years; Carroll D. Wright, for three years; E. L. Corthell, for two years; Henry Farquhar, for one year.
Member of General Committee—Le Grand Powers.

On Monday afternoon Hon. Carroll D. Wright, the retiring vice-president of the section, delivered an address on 'The Psychology of the Labor Question.'

Morning and afternoon meetings of the section for the presentation of papers were held on Tuesday, Wednesday and Friday. The program consisted of thirty-five papers. Abstracts of these papers are presented below.

The Economic Law of Competition and of Monopoly: ALLEN R. FOOTE, editor of *Public Policy.*

Mr. Foote in his paper pointed out that

all industries might be divided into two classes, viz., competitive and monopolistic. Under the head of competitive industries he included the production of all commodities which could be transported to be sold in markets other than that of their origin. Under monopolistic industries he classed public service corporations. He then proceeded to show that in competitive industries, if the price of the article sold was raised too high or so as to obtain an undue profit, fresh competition would be induced. On the other hand, the cost of a unit of production decreased as facilities for producing an increased number of units within a given time were developed or acquired. By example he showed that the economic selling-price for production in lots of 1,000 was less than the cost of producing in lots of 100. Consequently the producers of lots of 1,000 would kill off all producers in lots of 100. Similarly the economic selling-price for lots of 10,000 was less in cost of production for lots of 1,000. Finally, the economic selling-price for 1,000,000-lot production would be less than the cost in the 100,000-lot production. So that, ultimately, the largest producers of unit lot productions would kill off all smaller producers. Mr. Foote said that the large combinations which were able to turn out unit lot productions on an immense scale were public benefactors. They could not become odious monopolies because they were always bound to safeguard themselves against attack from competition and also against the possibility of making active the latent force of potential competition. Every reduction in selling-price broadened markets by bringing the product within the buying power of an ever-increasing number of consumers. This was the process which tended to make the luxuries of the rich the necessities of the poor. In order, however, for economic production to be carried on profitably along competitive lines, secrecy in management was absolutely essential. And this was true whether the producer was a single person or a large combination of corporations. The present anti-trust law and all other laws which made a distinction between different classes of manufacturers in competitive industries were illogical and indefensible as an interference with freedom of contract, were clearly in conflict with the natural law of economical development and were not really for the interest either of workmen or of consumers. Public service corporations, which were naturally monopolistic, Mr. Foote pointed out were on an entirely different footing; these should be strictly regulated by laws determining the cost price of services rendered and allowing, in addition thereto, a fair economic profit. This was all that could be done by public ownership, and, in Mr. Foote's opinion, when the public clearly realized this they would no longer place unnecessary burdens upon public service corporations, because each of these burdens had to be paid for by the consumer.

As a logical conclusion Mr. Foote suggests that the Sherman anti-trust law be revised to make it properly applicable to industrial corporations only, excluding from its operation inter-state transportation corporations, that the inter-state commerce law be revised properly to deal with inter-state transportation corporations only, and that the states take similar action applicable to business and public service corporations.

Remarks on Capitalization and Publicity: Hon. Martin A. Knapp, chairman of the Inter-State Commerce Commission.

Mr. Knapp discussed the proposition that all corporations under congressional control be required to make full disclosures

of their genesis and operations, so that it may be seen how the amount of money originally paid in, or the value of the assets at any time owned, compares with the par value of all bonds and stocks issued. He expressed doubts as to the soundness of the argument that publicity would prevent stock-watering, believing it unproved that the excessive issue of corporate securities was a source of such danger as to excite public alarm. He said he was yet to be convinced that enforced publicity would not be a harmful exercise of public authority.

His remarks were in part as follows: I maintain that the stockholder, as such, is not benefited by corporate publicity, and would be harmed rather than helped by its enforcement. It is one thing for the stockholder to have knowledge of the concern whose shares he holds; it is quite another thing to furnish the public the same information. I fail to see that publicity can be desirable to the stockholder. The justification for this proposal, therefore, must be found, if at all, in the theory that the state is charged with the duty of safeguarding the investment of capital in corporate securities. To my mind this is a most serious proposition, and I think we should long hesitate before embarking upon such a paternal venture. Leaving out the speculator and taking into account only those seeking honest investment, ten times more money, to say the least, has been sunk in farm mortgages, suburban lots, patent rights, buying and selling grain, cotton and other commodities, where no corporate shares were dealt in or even existed, than was ever lost on account of the fictitious or excessive issue of corporate securities. I can not but regard corporate publicity of the kind and to the extent advocated by many as a certain and serious hindrance to effective competition. Just as the Sherman anti-trust law, which is based upon an economic fallacy, has indirectly aided the very results it was designed to prevent, so the compulsory disclosure of all corporate transactions would undermine the competition it was intended to support. Bearing in mind how rapidly all kinds of business are assuming the corporate form, that the competition of individuals is fast disappearing, and that competition in the future will be mainly between corporations, it seems plain to me that the enforcement of corporate publicity would be an added incentive to industrial combination. Therefore, as I view the matter, the remedy in question will be worthless to the great mass of people, the consumers, for their troubles are not caused by watered stock and will not be alleviated by publicity. It will not benefit the actual stockholder, for however much he may need information for himself, his interests would not be promoted by bringing that information to public knowledge. Against its doubtful and very limited usefulness to the intending purchaser of corporate shares is the danger, not to be lightly estimated, of giving sanction to a principle of extreme paternalism and furnishing a fresh impulse, not to compete, but to consolidate.

The Necessity of Organization among Employers: DAVID M. PARRY, president of the National Association of Manufacturers.

The great need of the world to-day is organization—organization in every line of human effort. The workers of the land began to organize seventy-five years ago, and although their organizations have been by no means perfect, either as to management or numerical strength, yet they have been able, in consequence of them, to wield much power both with their employers and with

law-making bodies. But capital is as essential a factor in production as labor, and it is as necessary for the welfare of the country and the human race that its rights be recognized and protected as those of labor. In order to protect these rights organization is necessary. In union there is strength.

Heretofore in this country there has been no such thing as organized capital. It is true that there is consolidated capital—accumulations of capital brought together for the purpose of enlarging productive power—but consolidated capital is not organized capital. A definition of the latter term, I take it, should be an organization of men, engaged in different lines of industry, who are brought together for the purpose of protecting the general interests of capital, that the industrial prosperity of the country may be maintained and increased. Unorganized labor can not make known its wants, nor can unorganized capital do so.

The growing organization of labor in recent years makes it all the more imperative that capital organize. Although organized labor represents only fourteen per cent. of the sixteen millions of workers in this country, yet by its persistent agitation in the press and the political field it has in manifold ways affected the business and political life of the nation. It is to be admitted that it has accomplished much good. If it had done no more than to secure the standardizing of the coupler on freight cars by which loss of life has been minimized among railway employees, the right of labor to organize would be vindicated. There can be no question that there is a large field of usefulness for such organizations.

But while labor organizations can accomplish much good, they can also, if misguided, accomplish much evil—evil for the workingmen themselves as well as for progress and civilization. To-day these organizations are thoroughly permeated with socialistic principles, which they are attempting to put into practice, and which program, if successful, can not but result in industrial destruction. The four principles of trades-unionism to-day are: (1) Men shall have the right to say how long they shall work; (2) how much they shall turn out; (3) how much they shall get; (4) who shall be employed. If ever the employer declines to admit these propositions there is the strike and the boycott, and consequent industrial loss. If successful in enforcing their principles, there is also industrial loss, for these principles mean the bringing about of uniformity of effort among men, and a diminishing of their productive power, both of which must prove fatal to the best interests of humanity. Uniform effort means the squeezing of men into one puny mould, and the enthronement of sullen and impudent incompetency and stupidity. Decreased productive power means less consumable wealth to be distributed. Organized labor appears also enamored of the idea that all wealth produced must be distributed, thus preventing those accumulations of capital which tell so much for the increased productive power of a nation.

To combat the errors of organized labor is a duty which compels the organization of capital. Organized capital could also accomplish much in devising ways and means for the advancement of the commercial supremacy of the republic. When capital and labor are both organized they can sit down together and settle their disputes in an orderly and scientific way, and there would be an end to strikes and boycotts, hurtful to both.

The Right of the Laborer to His Job: WALTER S. LOGAN, New York city.

The question is considered under two heads: (1) The moral right, and (2) the legal right.

Under the first head Mr. Logan shows that the human species is of such a complicated structure, and the requirements of its existence and development so multiform, that labor is a necessity. Besides, we alone, of all the species that inhabit the earth, have organs which make productive and sustained labor on any considerable scale possible.

Labor, therefore, must have been not alone the necessity of our existence, but the intention of our creation.

Mr. Logan then argues that if labor is the necessary condition of our existence, and by labor alone can the apparent end of our creation be fulfilled, the right to labor—that is, the right to have a chance to labor—must be considered one of the primary rights of humanity.

Mr. Logan, summing up this branch of the subject, says:

"Theology and science both agree as to the substantial import of the decree which emanated from the garden of our nativity, whenever that garden and wherever that nativity was. By the sweat of man's brow he is to earn his daily bread. Call it a doom or a birthright, whichever you choose. The right is the necessary consequence of the necessity. If man *must* earn his daily bread he has a right to do so."

Under the second head, 'The Legal Right,' Mr. Logan argues that a legal right is only the formulation of a natural right. The statutes which punish killing do not *make* murder a crime; they simply recognize it as such. Mr. Logan says:

"If a man has a moral right to work there is some legal recognition of that right, or such legal recognition must be formulated whenever it is required.

"If the right was omitted from the enumerations in the Magna Charta or the Declaration of Independence, it was because those were times in which work, though comparatively unproductive, was plentiful. There was always enough to be done."

Mr. Logan's paper concludes with a description of the legislation which he conceives to be necessary to place the right of the workman to his job upon a solid legal basis. He concludes as follows:

"I think the time has come when we must rewrite the Declaration of Independence so that it will read, 'All men are entitled to certain inalienable rights, and among those rights are life, liberty and a job.'

"Perhaps that is the way the distinguished author of the Declaration intended it to be read. The phrase 'the pursuit of happiness' may have been only his synonym for 'a job.'"

Recent Aspects of the Immigration Problem: Professor ROLAND P. FALKNER, chief of the Division of Documents, Library of Congress.

The fact that in the last fiscal year immigration rose to a height almost unparalleled in our experience draws attention anew to the immigration question. In the closing decade of the century it had fallen off considerably and some felt that its end was drawing near. But it has taken a fresh start, and it behooves us to examine what is its contribution to our population and what are the questions which it raises. It is a mistaken idea to suppose that the foreign-born element grows apace with immigration. There are deaths in the ranks of the older settlers to be made up by the new before there can be a net gain. Though

half a million Germans came to the United States between 1890 and 1900, there were fewer Germans in the country at the latter date. But this does not account for the entire discrepancy in growth. In 1900 there were only ten per cent. of the immigrants arriving in the previous decade enumerated by the census. Some had died, some had returned to their native lands. This brings out the fact that the volume of immigration is an inaccurate criterion of the addition to the population, and is growing more so.

The ease of movement to the country is supplemented by the ease of getting away, and many of those who come to our shores are not true settlers among us, but passing visitors. This introduces a factor of the greatest moment. It has always been assumed by those who look upon immigration in an optimistic spirit that, however awkward he might be in his accomplishment, nothing was more characteristic of the new arrival than his desire to become an American, and many were content to take the will for the deed. But we are now confronted with immigrants who have no such desire; whose only wish is to make the most of their economic opportunities and enjoy the fruits of their toil elsewhere. It is highly desirable that statistical information be collected as to outgoing steerage passengers, that we may not be left to conjecture as to the extent of this movement.

We are frequently told that the immigrant would be welcome if he would go west and develop the country, but that he persists in staying in the eastern states and in crowding into the cities. However much public attention has been called to this matter, it is not exactly a new phase of the immigration problem, nor is it an indication of the perversity of the immigrant. The immigrant has not contributed much to the development of the country. He has followed in the wake of the nation, and at each census since 1850, when the foreign-born were first separately enumerated, they have been relatively more numerous in the eastern states. It can not be wondered that the foreign-born flock to the cities since the native-born do the same thing. Each follows the opportunities for labor. Since city growth is the characteristic of modern time, towns naturally attract population, particularly those elements not rooted by the possession of land to the soil. Groups of foreign-born in cities, moreover, yield sooner than like groups in rural districts to the contact with the English-speaking element, and here is some compensation.

But however unusual the phenomena noted, they should not, therefore, give less concern. The protection of the standard of life, or of American ideals, is the first duty of the statesman. The exclusion of all those who do not give reasonable promise of an ability and will to conform to our institutions is a duty which can not be put aside.

Bosnia: A Problem in Civil Administration: William E. Curtis, Washington, D. C.

William E. Curtis read from advance sheets of 'The Turk and His Lost Provinces' now in press, an interesting description of the regeneration by the Austrians of Bosnia, a former province of Turkey which was placed under their protection by the powers of Europe after the Turko-Russian war in 1878. At that time Bosnia was one of the most unhappy and hopeless places on earth; but since its release from Turkish domination it has become one of the most peaceful and prosperous provinces in Europe. Nowhere else in all the continent has there been so rapid

an increase in population and wealth or so profitable a development of natural resources.

Under the Turks murder was not considered a crime, and it is estimated that from ten to fifteen thousand people were killed annually by the soldiers and by each other. During the last ten years, out of a population of nearly two millions the homicides have averaged only six a year, and in 1900 there were only two. In Turkish times robbery was as common as lying, and farmers hid their cabins where they could not be seen from the highways, for fear of raids from bandits and marauding soldiers. There has been no case of robbery in Bosnia since 1895, and in 1900 but one case of burglary. Other crimes are equally rare.

The population of Bosnia is about 2,000,000, one third Moslems, one third members of the orthodox Greek church, one fifth Roman Catholics, and the remainder Protestants and Jews. The population has doubled in twenty years, and is increasing at the rate of ten per cent. a year. The people are peaceful, contented and prosperous. The cities are filled with new and handsome houses. Factories are being erected to utilize the water power and consume the raw material produced in the country. Training schools and other institutions have been established to qualify the people to make the most intelligent use of their opportunities. Members of the different religions mingle on amicable terms and show mutual respect and toleration. Taxes are low and are honestly collected and disbursed; the courts are wisely and justly administered, and the people have learned for the first time to appreciate a just and liberal government.

Bosnia is the first province of Turkey that was ever well governed. Enlightened Mohammedans who have observed the advantages are gradually yielding, and while no adult Moslem was ever converted to Christianity, they are adopting the customs of the western world, and their women are being released from the degrading position which they occupy in all the lands of Islam.

Mr. Curtis suggested that there was much in the Austrian experiment in Bosnia that might profitably be imitated by the United States in the Philippines.

The Sources and Margin of Error in Census Work: LE GRAND POWERS, Chief Statistician for Agriculture, U. S. Census.

The most important sources of error in census work are those of omission and duplication by the enumerators. Such errors have occurred in all census work.

In the census of agriculture the omissions are most numerous in sparsely settled sections where there is much irregular land surface. The duplications are most numerous in sections of the opposite character, and especially in communities with a large development of tenant farming.

The census office can and does check against duplications, and these checks have been more fully developed in the twelfth census than ever before. The office can not, during the work of schedule revision and tabulation, check against omissions of farm land by enumerators. Hence the probability of greater omissions than duplications in the completed report.

An analysis of census data, and comparisons of the same, with the records of assessed land, shows greater omissions than duplications in all parts of the country.

The omissions of farm land in Iowa equal about 1 per cent., and the duplications of errors of calculation or revision that have a tendency to unduly exaggerate

area aggregate about .8 per cent., thus leaving the final report less than a complete exhibit.

In Ohio, Indiana and Illinois, and in most of the older states, the margin of omissions exceeds the duplications and errors exaggerating results of not less than 2 or 3 per cent., and in the range states extending from western Kansas to the Pacific the margin of omission is from 20 to 25 per cent., and for the nation not less than 5.

The margin of error in staple crops, such as corn and wheat, is not, however, much, if any, greater than 1 per cent., and for minor crops, dairy products, poultry, etc., much greater, approximating 10 per cent.

The margin of error in the office work of the census due to errors in schedule revision, tabulation, result work, etc., varies from .1 to .5 per cent.

Requisites in Crop Reporting: H. Parker Willis, Washington, D. C.

The subject of crop reporting is of special interest at this time because of some dissatisfaction in the business world concerning the service now available. Within recent years there has been a lack of faith in the work done by the government offices, and this has rendered it of more than usual importance to study the methods of developing such a service along proper lines.

The first requisite in establishing a crop-report service is honesty in the officials in charge. This statement implies not mere personal honesty, but scientific truthfulness, freedom from bias and a display of the scientific spirit. As incidents to the attainment of these qualities the officials in charge of any crop-report service should of course be free from any pecuniary interest in that service, and devoid of bias in favor of any particular class in the community. They should not be permitted to speculate on the exchanges where those products which are affected by their reports are listed. Furthermore, the force working under them should be free from bias, and should be selected upon civil service principles, promotions being made after a non-partisan method. This applies not merely to the force in the office, but also to the outside force of correspondents, who ought not to represent any particular class, but should be selected in such a way that any bias manifested by any one class will be offset by the bias shown in the returns furnished by another. The returns should be absolutely public and should be furnished to all persons simultaneously. They should be public, not only as regards results, but as regards methods. In collecting the figures there should be an effort constantly to look for actual facts rather than for opinions. In other words, crop returns should, if possible, not be estimates at all, but should be representative of exact facts. Correspondents and all employees should be paid, for in this way more accurate and reliable results are obtained. The government should certainly not publish estimates. If, however, it is to do so there should be such a relationship between the office through which the basis for the estimates is obtained and the office furnishing those estimates, as to insure harmony of result.

Some Views of Recent Sociology: James H. Baker, president of the University of Colorado.

One conclusion is justified, namely, that social progress can not rely upon natural selection alone, but must bring to its aid all the forces of material and physical betterment, of public opinion, law, morality and religion.

Democratic government is the servant of the people; the will of the people can con-

trol its character and its tendencies; it is the necessary machinery for bringing about many reforms; and a people who have not the virtue and active energy to effect reforms through government are incapable of accomplishing them through any other organization of society or lack of organization.

Individual responsibility in social reform can not be too strongly urged. *Laissez faire* is materialism, fatalism, selfishness, savagery, indifference, laziness, mere subjective religious life and Pharisaism. It is the priest and the Levite, and not the Samaritan.

We may dismiss anarchism and revolutionary socialism at the outset. Even if in a distant age government control can be largely relaxed, abolition of government to-day, human nature being as it is, would necessitate the gradual reestablishment of government through a chaos and struggle which would be a repetition of Middle Ages history. Did we have the social state to-day, human nature being what it is, we should have under another form of organization an exaggeration of all the political corruption and selfishness and weakness which exist under present forms of government. In all civilized countries political changes will be an evolution and not a revolution. We may throw aside all supposed absolute rights and inflexible principles. Let the state do what it can do better than individuals.

Certainly we must recognize many causes of poverty. It is harmful to make a hobby of any one theory, or to try to find a panacea in any one remedy. Unwillingness may be subject to state regulation; lack of thrift, prodigality, etc., may be modified by philanthropic endeavor; inability can be removed in a percentage of cases by education and by the influence of such work as that of the 'settlements'; lack of opportunity for work can be met in part in times of distress by state or municipal provision for needed public improvements; various kinds of misfortune should be met by state provision and organized philanthropy; hopeless pauperism should be the state's care; inequitable distribution will be gradually modified by labor organizations and the development of altruistic principles in society. There is much of poverty that no plan of state or society can remove until the tone of the whole social organism is improved. I refer to the lack of aims and motives in those who are otherwise physically and mentally capable. The world is full of opportunities for establishing in thousands of centers, productive industrial activities, if the unemployed had the power of initiative. This whole subject is related to the problem of degeneracy.

That monopolies, so far as harmful in fact and tendency, should be subject to control is, I believe, the growing theory. The findings of the United States Industrial Commission, which has recently finished its labors, are significant, especially as the commission can not be charged *a priori* with undue hostility to wealth. These findings show the need of control through government, and the belief in its possibility and feasibility. Moreover, the very fact of the report shows that specialists, statesmen, and even politicians and monopolists are awake to the fact that reform must come.

In spite of certain biological doctrines of social evolution, in spite of the advocates of struggle, in spite of all *laissez faire* theories, one important fact must be recognized, namely, that human sympathy is growing and that human sympathy must be preserved in all its strength and purity; it is the bond that unites the units into a social aggregate. At the same time it is conceded by all scientific philanthropists

that, as struggle is modified by altruism, the unfit of every description are preserved to the detriment of the race as a whole, and that some humane solution of the difficulty must be sought. The burden of the state is becoming such that the causes of degeneracy must be in large part removed. The very fact that state and society are assuming the care of the unfortunate shows the growth of altruism and a recognition of the solidarity of society. The dependent, defective and delinquent classes are beginning to receive attention and study commensurate with the importance of their effect upon the welfare of the whole social fabric. Since all degeneracy is due to heredity or environment, state and society can reach and to some extent regulate the causes.

Since the struggle in human society is bound to be lessened, and race degeneration will surely follow unless degenerate tendencies are eliminated, what is the aspect of the problem? Society will no longer allow the unfortunate to perish. The answer seems to me plain and simple. Dickens in his marvelous study of social problems emphasized with terrible vividness the evils of society from neglected children when these should become grown and trained in vice, and hence powerful for harm. The work of improving the lower strata of society must begin with children. Educate the normal children of the poor, teach them some trade and start them right in life. Educate all who under right influence and training can become useful citizens. Remove waifs from unwholesome surroundings, or, rather, improve the surroundings. But in the name of humanity place all those who by nature must become hopeless paupers, imbeciles, all who by nature will become hopeless criminals, under permanent custodial care. Teach them some simple occupation and make them in part self-supporting. Segregate the sexes, that such unfortunates and society may be spared the fatal gift of degenerate offspring. This will do more to regenerate society than use-inheritance and all remedies proposed, except the great moral evolution of the race as a whole which I believe is going on.

Growth of Great Cities: ELMER L. CORTHELL, New York city.

At the annual meeting of the association held at Springfield, Mass., in 1895, the author offered a paper with a similar title.

The present paper gives the necessary summary of the former, and extends the curves of the diagram of growth and the data generally to include the census of 1900.

The growth of the eight cities under consideration is shown by a curve, the basis of which is the following: the periods from the earliest obtainable data to 1900 are measured from the ordinate, and the population of each census is measured from the abscissa.

It has been the aim of the author to show in the case of each city its *metropolitan* population; not simply that included within its political limits, but, in the case of London and Berlin, Greater London and Greater Berlin are also given.

The author gives a *table* of populations in addition to the curves of the diagram, to show the data for his latest extension of the curve of growth.

City.	Date.	Population.	Rate of Increase.
London	1900	4,589,129	8.6%
Greater London	1900	6,652,145	20.0
Paris (Greater)	1901	3,599,991	18.0
St. Petersburg	1897	1,132,677	15.5
Berlin	1900	1,884,157	12.0
Greater Berlin	1900	2,512,523	19.0
Vienna	1899	1,639,811	11.0
Philadelphia	1900	1,369,632	23.0
New York (Greater)	1900	3,833,999	37.0
New York (Manhattan Borough)	1900	1,850,093	29.0
Chicago	1900	1,838,735	54.0

The populations for the extreme or latest points on the curve are given above:

Likewise there is given with the above table the present rate of increase in population per decade; there is also stated the special features of each city—its area, density, etc.

As to density of population, this is shown graphically by squares on the diagram.

The comparisons in figures are as follows:

New York.—Maximum density, 630,740 per square mile on 3.6 acres. Average maximum density, 480,000 per square mile on 320 acres. Average density, New York city proper, 40,000 per square mile on 37 square miles.

London.—Maximum density, 132,000 per square mile on 357 acres. Average density (registration London), 37,000 per square mile on 117 square miles.

Paris.—Average density, 79,300 per square mile on 31 square miles.

St. Petersburg.—Maximum density, 227,276 per square mile. Average density, 28,260 per square mile on 35 square miles.

Berlin.—Maximum density, 92,600 per square mile. Average density, 67,612 per square mile, area 23.4 square miles.

Philadelphia.—Average density, 8,091 per square mile, area 129 square miles.

Chicago.—Average density, 8,430 per square mile, area 186 square miles.

The data for density were obtained about 1894.

A prediction is made of the population of each city in 1910 and 1920, taking into consideration important factors which are likely to change the present rates of increase, such as, first, the changes which new methods of transportation may bring about, either taking people more quickly and cheaply into cities, or out of them into more distant districts now open areas or sparsely settled country. Second, the congesting or overcrowding of city areas, making them too dense for comfort or health. These two conditions are already producing changes of magnitude in population. London is an instance of these effects, or of some others possibly; several of the central districts, instead of showing an increase, showed actual decrease in the last two census epochs.

It is difficult to predict now what change will take place in New York during the succeeding decades by the contemplated transportation changes; such as the opening of the new bridge over the East River, probable completion of the old Hudson River tunnel, the construction of the Rapid

City.	The Author's Estimated Population for 1900.	Actual Population, 1900.	Estimated Population in 1910.	Estimated Population in 1920.
Greater London	6,496,000	6,652,145	7,490,400	8,516,256
London	4,599,800	4,589,129	4,967,784	5,315,528
New York (Greater)	3,900,000	3,833,999 1901	4,953,000	6,191,250
Paris	2,697,300	2,660,559	2,967,030	3,234,063
Greater Paris		3,599,991	4,139,990	4,759,589
Berlin	2,101,400	1,884,157	2,731,820	3,496,729
Greater Berlin		2,512,523	2,914,517	3,322,549
*Greater Chicago	2,400,000	1,838,735	2,574,229	3,475,209
Philadelphia	1,414,500	1,369,632	1,697,400	2,002,932
St. Petersburg	1,185,600	1,132,677 1897	1,339,728	1,500,495

* Chicago. The erroneous estimates of population in 1894 require revision of prediction.

Transit Subway lines, the electrifying of the Manhattan Elevated and the extension of electric lines into the suburbs, and particularly by the construction of the Pennsylvania Railway's proposed tunnel under the rivers and New York, connecting New Jersey and Long Island with the central district of New York city, and additional facilities for handling passengers at the Great Central Depot and transferring them to the Subway.

It is not safe in such predictions to use *estimates* of population—nothing but the actual count by a census should be used. In 1895 the author was led astray by estimates of Chicago's population, and these erroneous estimates vitiated his predictions of population in 1900, 1910 and 1920. In cases where he based them upon reliable official returns his predictions were not far wrong for 1900.

As this feature of the paper is one of special interest, the table of predictions and its comparison with the actual populations of 1900 is given in full in this synopsis.

The author's object in obtaining the data and in writing the two papers for the association—one in 1895, and the other in 1902—is to furnish information that may be of use in solving some of the important transportation, economical and social problems relating to the great masses of humanity assembled in those great cities of over one million inhabitants.

In compiling a paper on the subject in 1910, it will be necessary to add several cities to the list in Great Britain, the United States and Argentina. Buenos Aires is likely to have a population of a million by the year 1906.

The Pan-American Union and the Bureau of the American Republics: Hon. W. W. ROCKHILL, director of the Bureau of American Republics.

The International Union of the American Republics, popularly known as the Pan-American Union, has existed since 1890. It was established by the International Conference of 1889–90, with the Bureau of the American Republics as its organ. The reason for its creation was the fostering of the friendly relations between all the republics, the dissemination of more general knowledge of the social and economic conditions obtaining in the various portions of the Western Hemisphere and for improving business intercourse and trade relations. In 1893 the publication of a monthly bulletin was inaugurated. It is a magazine published in the English, Spanish, Portuguese and French languages, containing information regarding the industries, trade, manufacture and general resources of the several republics. Its edition is 11,000 copies. The demand for these has been great, especially from the public schools of the country. An important work of the bureau is the publication of maps of the several republics on a uniform scale, giving general geographical as well as economic features, railway and telegraph lines, etc. A code of commercial nomenclature containing more than 50,000 terms in English, Spanish and Portuguese has been published by the bureau. The first international conference provided that the union should continue in force for ten years, and indicated the manner of its further continuance. It is now in the second decade of its existence. It was early recognized that the lack of an agency to carry on the work initiated by the first international conference was one of the chief reasons why it did not accomplish as much as its projectors anticipated. It was, therefore, determined by the second conference, held in Mexico in 1901–2, to reorganize the bureau, or rather to broaden and expand its existing organization. The

name was changed to the International Bureau of the American Republics, and its affairs placed under the supervision of a governing board composed of the Secretary of State of the United States, who is chairman, and the diplomatic representatives in Washington of all the other American republics represented in the bureau—in other words, of all the American republics—numbering twenty. The bureau is supported by contributions from all the republics in proportion to the number of inhabitants. Under the new plan the bureau corresponds, through the diplomatic representatives, with the executive departments of the several governments. It furnishes information to any of the republics requesting it. Each of the republics sends to it two copies of each of its official publications, and supplies such information as may, from time to time, be requested by the director. All of the publications of the bureau are public documents and as such carried free in the mails of all the republics. The bureau is the custodian of the archives of the international American conferences, and is charged with the performance of any executive work specially imposed upon it by the conferences. Among the duties was the fixing of the date of meeting of the commission for the study of the coffee crisis, and the sanitary and customs congresses.

The necessity of forming a good library, especially of the official publications of the American states, was recognized by the conference which founded the bureau. It originated with the idea of creating a monument to the work of the conference. The second conference by resolution designated the library as the 'Columbus Memorial Library.' It has about 10,000 volumes, chiefly of works on Latin America. The scope of the work of the bureau does not yet seem to have been limited definitely, and it is believed that in the future it may be found useful in many ways.

Work of the Bureau of Insular Affairs: Col. CLARENCE R. EDWARDS, chief of the Bureau of Insular Affairs, War Department.

At the close of the Spanish War, the War Department was brought face to face with a unique problem, *i. e.*, the establishment of a properly qualified civil government under military control in the surrendered territory, a territory that speedily included Cuba, Porto Rico and the Philippine Archipelago. The functions of an organized government, in harmony with American methods, had to be set in operation in an unpromising field. In a day almost, the United States was called upon to govern more than twice as many people as inhabited the United States at the close of the Revolution.

The War Department found itself without adequate machinery to handle this new work. Its bureaus were adapted to military requirements, while the new conditions extended to all classes of government affairs.

The chief clerk of the War Department states that, for the sake of ready reference, the earliest Cuban customs cases, being foreign to even the miscellaneous class of records filed in the long-established record division, were filed on his own desk. On December 13, 1898, there was created in the office of the Secretary of War the 'Division of Customs and Insular Affairs,' which has recently grown into the Bureau of Insular Affairs.

There is no more important branch of the bureau than the legal questions that have arisen. These questions develop a broad field for investigation, including the law of military occupation; the laws and usages of civilized warfare; international

law; interpretation of the constitution of the United States; interpretation of treaties respecting the territories subject to military occupation, etc.

Some of these many questions could not be disposed of by adherence to rules already established by judicial decisions. It was, therefore, necessary to extend the investigation into the field of history and see if the same or similar questions had arisen in the several instances of previous acquisition of foreign territory by the United States, and to learn how the question had been dealt with by the legislative and administrative branches of the government of the United States.

The Consular Service and Foreign Trade: Hon. Frederic Emory, chief of the Bureau of Foreign Commerce, Department of State.

A paper on the above subject was contributed by Frederic Emory, chief of the Bureau of Foreign Commerce, Department of State. That bureau has charge of the publication of consular reports on commercial and industrial subjects, from all parts of the world, and in recent years has greatly improved the efficiency and promptitude of this service.

Mr. Emory begins by quoting a recent address of Sir Edmund Monson, the British Ambassador to France, to the effect that the expansion of modern commerce and the many international questions it has created have had a strongly modifying influence upon diplomatic profession, which, instead of political intrigue, as in olden times, devotes itself now almost exclusively to business considerations.

If this be true of diplomacy, says Mr. Emory, it is even more generally applicable to the consular service. Diplomats are stationed only at the capitals of nations, but consular officers are found at all the important trade and industrial centers, and are thus brought into closer touch with the daily activities and currents of trade. For this reason they are usually in a better position to report the practical details so often wanted by a home industry or a mercantile house engaged in foreign trade. In the old days the consuls of European powers were usually selected with reference to their social qualities and general culture, and without much consideration of their possible usefulness to trade. In these days of sharp competition among the great producing nations, the business capacity and zeal of the consul in collecting information are found to be not only essential, but often a determining factor in the growth of commerce.

Mr. Emory's contention is that the United States consular service has been found to be superior to those of the other powers as a trade agency, for the very reason that the persons selected as consular officers being average Americans, as a rule, have had more of business aptitude than any other quality and have seldom been deterred by social considerations from giving their attention to 'trade.' Frequent complaint has been made of late in Great Britain that the English consular service has become very largely a caste or polite profession, instead of being what is now more urgently required—an active, wide-awake corps for the collection of commercial intelligence. It is precisely in this branch of work that the United States consular officers have shown themselves to be particularly alert and efficient. Mr. Emory argues from this state of facts that it would be unfortunate, in the reorganization of our consular service, to revert to the social or intellectual exclusiveness found by Europeans to be no longer justified by existing conditions, and that the logic of our experience incontestably proves the im-

portance of giving the greatest weight to the business capacity and general intelligence of the individual consul.

The Relation Between Exports and Imports: Hon. T. E. BURTON, U. S. House of Representatives.

In determining the wealth or prosperity of a country nothing is more generally noticed than the relation between exports and imports, the so-called 'balance of trade.' An excess of exports is regarded as indicating prosperity. Yet, independently considered, nothing could be more misleading. In order to ascertain the significance of this relation it is necessary to consider a number of circumstances, chief among which are the condition of the country in question, whether a debtor or creditor country, in which connection the income derived from loans and investments in other countries, as well as from shipping engaged in international carrying trade, must be taken into account; the stage of development; the quality of imports and the uses to which they are applied, particularly whether they be raw material to be utilized in manufacture, or other material to be employed in increasing the productive power of the country. In the final analysis, the comparative utility of that which is received and that which is disposed of must be determined, regardless of valuations.

Countries receiving tribute or contributions from other lands, like Rome in the days of its supremacy, or Germany after payment of the French indemnity, show a large excess of imports.

In the United Kingdom the great excess in the value of imports is approximately equaled year by year by the income from investments abroad, and the carrying trade. In new countries rich in resources, exports naturally exceed imports, but when a developing stage begins much material is imported from more advanced countries. Imports increase until the improved equipment for production acquired by large importations makes itself felt in excess of exports again.

After due allowance has been made for all these modifying circumstances and exceptions, the fact remains that a country importing largely in excess of its exports, when such excess is not derived from the income of a surplus accumulated in the past, or is not devoted to development for the future, gives sign of economic decay.

The annual excess of imports in countries furnishing commercial statistics is more than one billion of dollars. This excess, though made up partly of carrying charges and profits of trade, where these items are counted in the valuation of imports, can only be explained by the superior utility of commodities in the countries into which they are imported, a fact which necessarily influences valuations.

The phenomenal excess of exports of the United States during recent years can only be explained by realizing that we have gained a new position as the purveyor of the world's wants. It is impossible that this great disparity of exports can continue. There is an inevitable tendency, whenever a nation obtains great accretions of wealth, to increase purchases abroad. In the last two years the excess has been diminishing, but other favorable indications appear in the relation between exports and imports, such as the increased proportion of raw material imported for manufacturing. In our foreign trade, as well as in all other ways, all signs point to the assured supremacy of the United States.

Tropical Development a Necessity of World Progress: Hon. O. P. AUSTIN, chief of the Bureau of Statistics, Treasury Department.

The principal suggestions of Mr. Austin's paper were:

1. That the increasing population of the world and the increasing facilities for transportation require that its various sections shall contribute their proper proportion to the requirements of man.

2. That the world, and especially the temperate zones, is constantly increasing its demands for tropical and subtropical products.

3. That although the belt lying between the thirtieth parallels of north and south latitude contains practically half the land area of the world, it contributes but one sixth of the exports which enter into the international commerce of the world.

4. That conditions in the temperate zones are such as to render available surplus capital, energy and experience which may now be devoted to the development of the tropics.

5. That recent discoveries for the protection of life and health in the tropics, and the use of natural power, will now enable the temperate-zone man to accomplish many things in the tropics not possible in earlier years.

6. That those sections of the tropics in which the native labor supply is insufficient may be readily supplied with the necessary amount of tropical labor from India, southern China and other sections of the Orient whose populations have shown themselves capable of and willing to labor in the tropics.

7. That the development of comparatively recent years has brought practically all of the tropics, except tropical America, under control of temperate-zone countries, thus facilitating the application in the tropics of the capital and energy of the temperate-zone man.

Economic Operations of the Treasury Department: Hon. Milton E. Ailes, Assistant Secretary of the Treasury.

The economic operations of the department relate chiefly to the management of the revenues. In the public mind this part of the treasury work is what makes or unmakes a secretary of the treasury. The world little knows or cares how heavily burdened that officer may be with the management of the customs (unless he examines baggage over-zealously) or how a secretary of the treasury lies awake at night devising ways and means for stamping out the latest yellow fever epidemic, or is harassed with the intricacies of constructing innumerable public buildings or caring for more than three hundred already in existence. When storms ravage the coast it is the Secretary of the Treasury who prays that not one of the keepers of his 1,200 lights and lighthouses may have failed, or that any of the surfmen of the life-saving service have been found wanting in courage at the supreme hour. It is the Secretary of the Treasury who must know that navigators' charts from the Coast and Geodetic Survey are correct, that the Steamboat Inspection Service has done its work faithfully, and, in fact, that all of the 26,000 employees accredited to his department and engaged in its many and varied services are faithful to their trusts. And yet, he must keep his fingers on the pulse of government receipts and disbursements. He must observe an approaching deficiency and give timely warning to congress, or arrange for public loans, in order that the treasury may be replenished and strengthened. In the days of prosperity he must also observe the phenomena of a surplus. Accumulating funds in the treasury mean withdrawals of money hitherto profitably employed in trade or business, and so he must set about to apply a remedy.

Under our system government revenues increase when business is most active throughout the country. The result, unless carefully guarded against, is a lock-up of money in the treasury just when it is most needed elsewhere. When the crop-moving time comes in the fall, and the great money centers are sending currency to interior points, the treasury is bombarded with requests for relief. As the rates for money advance, the cry becomes louder. For more than half a century now, it has been the established policy of the government to heed that cry, especially when it is apparent that the treasury itself is a disturbing factor. Recent experiences demonstrate what must and should be done so long as our system permits the hoarding of funds in government vaults, and so long as that situation is complicated by an unsatisfactory bank-note circulation not related to the expanding and contracting wants of commerce. Within the past few months the Secretary of the Treasury by extraordinary efforts succeeded in stimulating national banks to take out some $25,000,000 additional circulation. He also increased the amount of public funds which national banks are permitted to hold by $24,000,000. He anticipated the payment of interest on the public debt for October and November without rebate, and for the whole of the fiscal year, to such as cared to avail themselves of the offer, subject to a rebate of two tenths of one per cent. a month, by means of which latter method he succeeded in paying out $3,000,000 more, with a profit of over $40,000 to the treasury; and finally, when the business of the country demanded still further relief, he anticipated a portion of the public debt itself by buying bonds and thus releasing some $23,000,000. By the time the crop-moving season was over the amount of cash actually locked up in the treasury had been reduced by nearly $50,000,000, and there was left in the treasury vaults only a little over $50,000,000, which tradition and practice have established as a fair working balance. The responsibility for managing the public funds is a heavy one, but it has been met at all times, and under all administrations, by every Secretary of the Treasury, with high courage and devoted effort to keep the treasury as near as may be out of the business world, to avoid the well-recognized evils that exist, and to take advantage of all the good there is in our present national financial system.

Effects of the Inflow of Gold: HON. ELLIS H. ROBERTS, Treasurer of the United States.

The stock of gold in the United States shows for four years an annual average gain of $107,783,639. All the countries of Europe show such a gain less by $12,358,639. In per capita the stock of gold in this country is greater than anywhere else, except in France and South Africa. The treasury of the United States holds $615,000,000 and gained $412,450,562 in five years, while all the official banks of Europe taken together in the same period lost $37,477,102.

Upon such treasures our currency rests solid and impregnable. An attack on our reserves may be conceived, but it would be to besiege Gibraltar with carbines. The inflow of gold has, since July 1, 1897, added an average of $78,238,512 every year to our circulation. Here lies possible peril. Inflation of currency incites to dangerous expansion of business. No one will suggest that the incoming of gold shall be stopped; but can not paper currency be reduced in dull seasons?

Prices of commodities have advanced, and wages have followed a little after. How do these conditions affect our world

relations? With our stock of gold, our official holdings, and our gold in circulation exceeding those of any other country, and growing more rapidly in gross and per capita than those of any other people, this land becomes more and more the home of gold. The solidity of our financial system adds much to the strength of the United States in commercial credit, general esteem and international politics in all the world. We fear no evil from exports of gold, for we can spare more than Europe can pay for.

Has inflation of currency, of prices and wages gone so far as to check our exports? In agriculture crops at home and abroad determine shipments. Prices and quality control exports of manufactures. In the first ten months of 1902 we sold abroad more manufactured articles than in any like period except 1900, and they were 32.63 per cent. of our total exports, the largest on record. The inflow of gold is not without its hazards. They must be avoided. The American people are sane enough to make gold not only the symbol of prosperity, but its stout defense.

Monetary Reform: Hon. George E. Roberts, director of the Mint.

Mr. Roberts's paper was chiefly devoted to bank-note issues upon ordinary commercial assets. He said in part:

The objector to note issues without special security wants first of all to divest himself of the idea that note redemption depends solely or primarily upon the gold reserve in the banks. That is a reserve and guarantee fund, but the regular redemption of a scientific bank-note currency is through a clearing house by a system of offsets. Under the Fowler Bill, now pending in Congress, each bank would send the notes of other banks that came to its counter to its correspondent in the clearing-house city of its district. It would have a double object in doing this: (1) It would prefer to pay out its own notes instead of theirs, and (2) it would do it to have an offset to its own notes in the clearing house and to build up its gold reserve there. The whole plan is simply a further development of the clearing-house idea as we have it in operation for drafts and checks. It is a further economy in the exchanges, a further substitution of an inexpensive medium.

So long as a bank confined its note issue to the service of its regular daily, legitimate trade, to giving the ordinary accommodation to farmers, manufacturers and merchants in their business, there would be no important balances against it at the clearing house, because the legitimate trade of the country offsets itself. But as soon as a bank began greedily to push its circulation by unusual methods or unusual credits, adverse balances at the clearing house would begin to appear and its gold reserve to dwindle. So long as a bank did only the business that a bank ought to do, redemption would be no problem at all, but the moment it departed from that policy, it would have to suffer and settle at every misstep.

It is a familiar fact that the fall of every year brings tight money in the United States, due to the moving of crops and the activity of trade. There is need of more currency, more instruments of exchange, in that part of the year than at any other time, and our monetary system does not respond to such special demands. When money is easy it accumulates in the centers, fosters speculation and becomes more or less engaged there, and then when the fall demand comes on, there is a wail over its withdrawal because it forces liquidation and unsettles business. These credit notes of local banks would not be likely to have general circulation, for the reason that the

banks of each locality would keep their neighborhood clear of foreign currency. They would not accumulate in the centers because they would not be good in the reserves of the city banks. They are not available as a basis of credit. They can be used only as a circulating medium. This distinction between the bank note and our other forms of paper money is the feature to which attention is directed. It follows from this and from the experience of similar systems that the local banks all over the country would have in ordinary times a reserve of circulation to put out whenever business was active enough to absorb it. The volume of circulation would naturally expand in the fall of the year and contract as business slackened.

Inflation through the Expansion of Bank Deposits: Professor JOSEPH FRENCH JOHNSON, New York University.

Professor Johnson pointed out that bank deposits are of two classes. (1) Those which result from a deposit of cash or of checks and drafts with a bank. These he styled cash deposits. (2) Deposits which are the result of a credit operation, the borrower taking, not money, but a deposit account. These he called credit deposits. The cash deposits can not be increased at will by the banker. They represent the savings of a community, wealth that has been produced and is not wanted by the producer. The credit deposits may be increased at the discretion of the banker. They represent savings in the process of being made, wealth being produced. Both classes of deposits give rise to a large mass of checks and drafts which constitute a medium of exchange known as deposit currency. Inasmuch as bankers have some discretion in the expansion of their credit deposits, the supply of deposit currency in a country is always dependent upon the policy pursued by the banks. Through an unwise expansion of their credit deposits banks are able to bring about a very dangerous increase or inflation of the deposit currency. In good times, when a speculative spirit easily gets possession of business men, bankers are always liable to encourage speculation, and the consequent rise of prices, by the expansion of their credit deposits, and a larger portion of the country's monetary stock, is drawn into the banking reserves as a basis for the extended credits. The increase of the banking reserve, it should be noted, is very slight in comparison with the concurrent increase of the deposit currency. Inflation of the medium of exchange in this way is more dangerous and can be carried to greater length than any inflation possible through a free issue of bank notes. In the case of bank notes an automatic check operates to prevent an over-issue. A definite amount of hand-to-hand money is wanted by the community, and if any excess is put into circulation, it speedily finds its way back to the issuing bank. No such instant automatic check is applied in the case of inflation through an increase of deposit currency. A brake is always applied, but not promptly. An undue inflation of deposit currency inflates prices quite as effectively as an increase in the stock of money itself, and so finally disturbs our foreign trade relations, bringing about a balance of indebtedness that renders the export of gold necessary. This export of gold forces bankers to contract their operations and often brings injury upon men whose business enterprises are in every respect deserving of assistance.

FRANK H. HITCHCOCK,
Secretary.

(*To be concluded.*)

*THE EDENTATA OF THE SANTA CRUZ BEDS.**

In the Santa Cruz fauna the edentates form one of the most conspicuous elements, both in the abundance of individuals and in the number and variety of the genera and species. As a whole, they are strikingly different from those of recent times, for of the three orders which are represented among the fossils, armadillos, glyptodonts and ground-sloths, only the first-named persists to the present day, the other two being extinct. On the other hand, no trace has yet been found in the Santa Cruz beds of the true sloths or of the anteaters. It can hardly be doubted that both of these orders had already become differentiated and were in existence as such. If so, however, they must have originated in some other part of the South American continent, and were prevented by climatic or other barriers from extending their range into Patagonia. One fact which clearly justifies this assumption is the relatively small degree of structural change that took place between the edentates of the Santa Cruz and those of later periods, such as the Pampean. There are many differences of detail between the earlier and the later forms, but nothing comparable to what would be implied in the derivation of the sloths or anteaters from any known Santa Cruz fossils.

As will be shown more at length in a later section, much the same statement applies to the armadillos of the Santa Cruz beds, with reference to their connection with those of modern times. Speaking broadly, the latter would appear not to have been derived from the former, which suggests that Miocene Patagonia was rather an outpost of the South American fauna than the main area of its development.

The Santa Cruz glyptodonts are, on the whole, markedly more primitive than those of the Pampean, and in many structural details show a closer connection with the armadillos than do the latter; but for the most part, the Santa Cruz genera do not appear to be directly ancestral to those of the Pampean. Like the armadillos, they seem to be aside from the main lines of descent which terminated in the giant types of the Pleistocene.

On the other hand, the Gravigrada appear to be more directly ancestral to the great Pampean forms, and representatives, if not the actual ancestors, of almost all the genera may be observed in this fauna. However, no entirely convincing solution of these problems can be obtained until the fossils intermediate in time between the Santa Cruz and the Pampean are more fully known.

A remarkable feature of the Santa Cruz edentates is their variability within certain well-defined limits. As a rule, the genera may be readily identified, but the species, especially of the Glyptodontia and Gravigrada, present extraordinary difficulties to the systematist. This variability, however, confines itself to comparatively unimportant details, and the characteristics of the three orders and of the families and genera within those orders are already, for the most part, firmly established, though transitional forms from species to species and, less commonly, from genus to genus abound.

1. The Santa Cruz edentates are relatively small animals and a few of them are really minute. As compared with the ground-sloths and glyptodonts of the Pampean, they are pygmies, but the armadillos have a greater number of large species than exist at present, though none of them

* From the forthcoming Vol. V. of the 'Reports of the Princeton University Expeditions to Patagonia.'

is gigantic, or comparable to such a form as *Macroeuphractus*.

2. Fully developed carapaces are found in all of the armadillos and glyptodonts of the period, but as yet no dermal ossifications have been found in connection with any of the ground-sloths. This is the less surprising, because very little is known of the skeleton of the Santa Cruz *Mylodontidæ,* the only family in which these ossifications could be expected to occur.

3. The teeth are in all cases devoid of enamel, rootless and tubular, though they may be lobate, examples of which occur in all three of the orders. No trace of a milk-dentition has been observed. Premaxillary teeth and the corresponding mandibular teeth have been definitely found only in the armadillos, though rudimentary traces of such teeth are apparent in some of the glyptodonts and they may also occur in a few of the ground-sloths.

4. The skull has few common features throughout the series, each order having its own characteristic type of structure. The difference is largely in the relative development of the cranial and facial regions, which varies from the extremely elongate skull, with long, slender rostrum, of the armadillos, to the short, broad, deep and almost cubical skull of the glyptodonts. Sagittal and occipital crests are never very strongly marked, but they are present in most genera of all three orders, and there is no such development of cranial air-sinuses as took place at a later period. In all of the known genera from this formation, except *Peltephilus,* there is a more or less prominent descending, suborbital process given off from the zygomatic arch; it may be formed by the jugal alone or by the jugal and maxillary, and in position it may be at the anterior or the posterior end, or in the middle of the arch. The arch itself is always complete, never rudimentary, though in the Gravigrada the jugal is usually loosely attached, and has been lost from most of the specimens.

5. The neck has never more or less than seven vertebræ, though in all of the armadillos and glyptodonts the apparent number is much reduced by coossification. In the same two groups the trunk is short and the number of trunk-vertebræ small, and in the glyptodonts these vertebræ are coossified into long 'tubes,' one thoracic, the other lumbo-sacral. In the Gravigrada, on the contrary, the trunk is very long and the trunk-vertebræ numerous. In both armadillos and ground-sloths the lumbar and posterior thoracic vertebræ have very complex accessory zygapophyses, which in the former are as fully developed as at the present time, but in the latter are somewhat less so than they became at a later period. The sacrum may be long (Dasypoda, Glyptodontia) or short (Gravigrada), but always articulates with both ilia and ischia. The tail is sometimes of moderate length and sometimes very long, but always heavy and always has a complete series of chevron-bones.

6. The limbs and feet differ greatly in the three orders, and have comparatively little in common. The scapula is broad and has an extremely prominent spine and acromion; the coracoid is very large in the ground-sloths, reduced in the glyptodonts and armadillos, except *Peltephilus.* In all three orders the humerus has a similar general appearance, having small tuberosities, extremely prominent deltoid and supinator ridges and internal epicondyle, while the foramen is large. Ulna and radius are separate and, except in the ground-sloths, the former has a very large olecranon. All the carpals are free, but no genus has been found which has the centrale. The manus is pentadactyl and plantigrade, though it is not improbable

that the Gravigrada had already begun to rest the ulnar edge of the hand upon the ground; the metacarpals are free and, except in one species of armadillo, none of the phalanges are coossified. The unguals are generally longer and more pointed than in the pes.

The pelvis differs much in the three groups, but always the ischia are extensively connected with the sacrum. The femur is long and has prominent trochanters, and in some of the armadillos the great trochanter reaches extraordinary proportions. Tibia and fibula are free in the Gravigrada, coalesced at both ends in the glyptodonts and armadillos. The pes is pentadactyl and, except in the glyptodonts, is plantigrade, while in the latter group it is semidigitigrade. No coossification occurs in tarsus, metatarsus or phalanges, and the unguals, which in the ground-sloths are large claws, in the other two orders are more or less hoof-like, completely so in the glyptodonts.

DASYPODA.

The Santa Cruz armadillos form a peculiar assemblage of types, very unlike, as a whole, the modern representatives of the suborder, for only one, or possibly two, species would appear to be directly ancestral to existing forms, while the majority belong to extinct lines. Some of these lines, like that of *Proeutatus,* for example, persisted till a much later period than the Santa Cruz, and reached their culmination in the Pampean, but have no representatives in the recent fauna, while other series, like *Stegotherium* and the extraordinary *Peltephilus,* are not known to pass beyond the limits of the Santa Cruz formation. At the same time, there is a very notable diversity among these armadillos, and no less than three families and seven genera have been described, most of the genera having each several species. The discovery of more complete material may reduce these numbers, but the variety will continue to be remarkable.

Attention has already been called to the difference between the Santa Cruz and the recent armadillos, a difference which can be made clear in a few words. No probable forerunner of *Dasypus, Priodontes, Tolypeutes, Chalamydophorus* or *Tatu,* has been found in these beds, though some one of the species of *Prozaëdius* was almost certainly an ancestor of the recent *Zaëdyus* —it is possible, though far from certain, that some species of *Stenotatus* stood in the same relation to the modern *Cabassous.* In view of the stage of differentiation attained by the Santa Cruz armadillos, it is most improbable that all of these modern types should have originated since that period. This confirms the conclusion indicated by several other mammalian series, that in Miocene times Patagonia was not the principal theater of evolution of the South American fauna. This would explain the entire absence from the Santa Cruz beds of many types which would naturally be expected to occur there.

In general, the armadillos of this period may be said to have attained nearly the modern degree of specialization, though, in many details, primitive characteristics have been retained. As Ameghino has pointed out, the carapace never has an anterior buckler, but is made up of movable, imbricating bands, except posteriorly, where a larger or smaller number of plates are joined together by their edges to make the pelvic buckler. In one genus, *Prœuphractus* (*fide* Ameghino) there is no pelvic buckler, all the plates being movable, and it is uncertain whether this was not also true of *Stegotherium.* In *Peltephilus* the pelvic buckler would appear to have been very loosely formed, the plates merely

touching one another, though in this region they are not imbricating. The cephalic shield is usually composed of numerous small, non-imbricating, irregularly polygonal and rather heavy plates, which are finely pitted, but display no regular sculptural pattern, but in the altogether exceptional genus *Peltephilus* these plates are large, very thick and coarsely sculptured. A further remarkable peculiarity of the head-shield in this genus is the presence of one or two pairs of pointed, horn-like scutes upon the rostrum. It is a curious fact that no plates of the tail-sheath have been found in association with any of the genera, except *Peltephilus*. It seems most unlikely that all the other genera had unarmored tails, and yet, in view of the large number of well-preserved specimens, including the caudal vertebræ, that have been collected, it is possible that such may have been the case.

Considerable variety is displayed in the dentition, though in no species has any trace of enamel or of the milk-teeth been observed. The marked diphyodontism of the modern *Tatu* makes this fact somewhat surprising. Premaxillary teeth and the corresponding mandibular teeth occur in two genera, *Proeutatus* and *Peltephilus*, and in the latter they are so closely approximated that the teeth of both upper and lower jaws form a continuous series. *Prozaëdius* and *Stenotatus* have teeth like those of most recent armadillos, while in *Proeutatus* the teeth show an incipient division into lobes and have a complex masticating surface, produced by layers of dentine of different hardness and color, and with some resemblance to the teeth of the glyptodonts. In *Peltephilus* the teeth are sharply pointed and form what appears to have been a formidable lacerating apparatus, while, finally, in *Stegotherium* the dentition is in such an extreme state of reduction that the animal must have been functionally all but edentulous.

In all the known genera, except *Peltephilus*, the skull has a very elongate and usually a slender rostrum, and, with the same exception, the zygomatic arch has a prominent descending, suborbital process, which is generally from the jugal, but sometimes from the zygomatic process of the maxillary also.

The cervical vertebræ closely resemble those of the modern armadillos, one or two vertebræ coalescing with the axis. The trunk is short, and in those genera in which the number is known does not contain more than eleven thoracic and four lumbar vertebræ; in the lumbar and the posterior part of the thoracic regions the vertebræ have the same complex mode of articulation, by means of accessory zygapophyses, as is found in recent genera. The sacrum is long and always has an extensive union with the ischia. The tail varies considerably in the different genera; it is usually quite elongated, but in some of the genera, as *Proeutatus*, it is of only moderate length, though very heavy; in *Stegotherium* the caudal vertebræ are remarkable for the great development of their transverse process. The ribs, both costal and sternal, and the sternum, differ in no important respect from those of the recent armadillos.

The shoulder-girdle is practically the same as in the existing genera, but the humerus is noteworthy for the great size and prominence of the deltoid ridge, and the epicondylar foramen is always present. The ulna has a very large olecranon, which in most of the species terminates proximally in a prominent, incurved hook. The manus is always pentadactyl and all the digits bear claws; in all known species

the second digit is the longest of the series. In only one genus, *Stenotatus*, are any of the phalanges coossified. The ungual phalanges are always long, heavy, decurved and pointed, and were evidently well adapted to burrowing habits.

The pelvis varies considerably in the different genera, but does not depart widely from the modern type. The femur is elongate and has a very prominent great trochanter, which in *Proeutatus* reaches remarkable proportions; the third trochanter is also well developed in all cases. As in the recent armadillos, the tibia and fibula are invariably coossified at both the proximal and the distal ends. Like the manus, the pes is always pentadactyl, though in some of the genera, and especially in *Peltephilus*, the lateral digits are much reduced. The ungual phalanges are usually much shorter and broader than those of the manus, and are often more like hoofs than claws.

In size, there is much variety among the Santa Cruz armadillos, ranging from the minute *Prozaëdius* to *Proeutatus*, some species of which are larger than any existing armadillo, except *Priodontes*, while the very incompletely known *Peltephilus grandis* may have equaled or even surpassed the latter.

To sum up: The Santa Cruz armadillos differ comparatively little in appearance or in structure from the modern ones, and yet it is apparent that they do not, as a whole, represent the main line of descent which ended in the recent genera. That evolution must have taken place in some other region of the South American continent, doubtless the same region as that which gave rise to the true sloths and the anteaters.

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SCIENTIFIC BOOKS.

The Constructive Development of Group-theory; with a Bibliography. By B. S. Easton. Boston, Ginn & Co. 1902. Pp. iv + 89. Cloth, \$0.75. (Publications of the University of Pennsylvania, series of mathematics, No. 2.)

This monograph aims to present in continuous form, but omitting all proofs, the main concepts and results of abstract and substitution group theory. While the theory of linear groups is expressly excluded, some of its results are tabulated on pages 83 and 84 under 'systems of simple groups.'

Employing a set of abbreviations for the journals, the author has succeeded, in the short space of thirty-four pages, in giving an exhaustive bibliography of the subject. In it appear 157 names of authors. To further indicate its extent, we note that it gives 97 titles by G. A. Miller, 35 by L. E. Dickson, 33 by C. Jordan, 23 by W. Burnside, 21 by Cayley, 20 by Cauchy and 16 by Kronecker.

The treatise proper extends over 39 pages, the successive headings being as follows: substitutions, groups, substitution groups, conjugacy, multiple isomorphism and quotient-groups, composition series, commutators, Abelian groups, groups or order a power of a prime, Sylow's theorem and its extensions, Hamiltonian groups, transitivity, intransitivity, primitivity, regular groups, imprimitivity, multiple transitivity, class of a group and degree of transitivity, automorphism, representation, index notation.

The tables give the numbers of distinct abstract groups of each order as far as 63; the number of substitution groups of each degree as far as 18, classified as multiply transitive, other primitive, imprimitive, and intransitive; the types of group of orders p^2, pq, p^3, pq^2, pqr, $8p (p > 2)$, 16, $p^4 (p > 2)$, p^3q, 32, $p^5 (p > 2)$; simple groups of low orders; orders of composite and soluble groups; systems of simple groups.

Some minor remarks or corrections are here in order. In § 21, for 'class' read 'degree.' In § 44, for 'product of two elements' read 'product of any two elements.' In § 26, add alternative designation 'commutative

group' and remark that 'abelian group' is used in an entirely different sense in linear group theory. In § 38, on abstract groups, it is stated that 'these generating elements define the group completely,' whereas the generating elements with a complete set of generational relations are necessary for the definition of the group; also as alternative for 'equations' should be given 'generational relations.' In § 63 add 'itself and.' In § 73, 3 the correspondence should be defined. For $(m-1)$ read $(m, 1)$. In § 74, for $(m-n)$ read (m, n). In §85, the identity group is not, as usual, included in the composition series. In § 239 is quoted incorrectly the reviewer's generalization of Hermite's theorem on the analytic representation of a substitution of degree p^a. The two congruences modulo p^a should be equations in the Galois field of order p^a. Since the variable z is indeterminate in the field, the only reduction consists in applying the algebraic equation $z^{p^a}=z$ and reducing the coefficients modulo p. In formula 9 of page 84, $p^{3n}-1$ should read $p^{2n}-1$.

For so elaborate a piece of work, executed with such thoroughness and success, both the specialist and the beginner in group theory must feel most grateful. In pointing out various errors in the literature, a valuable service has been rendered to the student.

L. E. DICKSON.

Pathologische Pflanzenanatomie. E. KÜSTER. Gustav Fischer, Jena. 1903. 8vo. Pp. iv + 312; 121 figs.

Dr. Küster's investigations upon gall-formations and structures of similar character in the plant has led him to a discussion of the entire subject of pathological anatomy of plants. The text-book resulting from this treatment of the subject takes into consideration the major structures that might be considered as histological or organographical departures from the normal, but does not include degenerations, or the phenomena of decay due to fungi or other causes.

The various abnormalities are classified according to the cytological and topographical features presented by their development, and are embraced under the following general heads: Restitution, Hypoplasie, Metaplasie, Hypertrophie and Hyperplasie. *Restitution* is the term applied to all processes set in activity by the loss of a tissue or an organ, and may include the replacement of the lost members by the development of new ones on adjacent parts of the body, or on the injured surface; the substitution of an organ of a different character arising on the injured surface, or the substitution of an organ of a different character on adjacent portions of the plant. *Hypoplasie* includes all processes resulting from disturbances of any kind in which the number, size or differentiation of the cells does not attain the normal. *Metaplasie* is taken to include all development of the protoplasts by which their structure, composition, form or character of the membrane is different from the normal, and includes all progressive changes of the cell not connected with growth and division. *Hypertrophy* is used in its accepted sense to designate the production of abnormally large cells which may be aggregated in such manner as to result in abnormally large organs. Such enlargements may ensue in meristematic or permanent tissues. *Hyperplasie* is used to designate the abnormal increase in the volume of a tissue resulting from an unusual multiplication of the cells. Such increase in the number of cells may consist in the formation of a surplus number of the ordinary tissues, or by the formation of cells of a different character, such as in galls or calluses.

The two last-named divisions of the subject are of the greatest importance from the standpoint of the practical pathologist, and are given an adequate treatment in the present volume. These sections of the book owe much of their value to the original matter adduced by the author from his own investigation. The concluding section of the book consists in a general consideration of the etiology and morphology and pathological structures, and sets forth some of the more important problems of general pathology.

Dr. Küster's book is invaluable to the student of plant pathology, and has much more to commend it than any of the few reading books on the subject which have been written

in English, or been translated into that language. Its interest is scarcely less for the physiologist and for the botanist concerned with the problems of alterations and adaptations of structure.

D. T. MacDougal.

New York Botanical Garden,
Bronx Park.

Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere. Allgemeiner Theil. Erste und Zweite Auflage. Zweite Lieferung. By E. Korschelt and K. Heider. Jena, Gustav Fisher. 1903.

The second instalment of the general part of Korschelt and Heider's 'Lehrbuch,' which has recently appeared, maintains the high standard of excellence which we have learned to expect from these authors. The instalment includes only the sixth chapter, that dealing with the maturation of the germ cells and with the phenomena of fertilization, but it runs to more than two hundred large octavo pages and contains over eighty figures. These numbers will give some idea of the comprehensiveness with which the subjects named have been treated, especially if it be remembered that not a little collateral material was considered in the first instalment of the work and is, therefore, omitted or merely referred to in the present part.

When all is of such general excellence it may seem invidious to make special mention of certain of the sections. In section IV., however, there is presented an admirable statement and discussion of the maturation divisions in their relation to the reduction question, and in its presentation certain new terms are introduced to indicate the three methods of maturation division recognized by Häcker. To the method, observed by Boveri in *Ascaris*, in which both the divisions of the chromosomes are longitudinal and in which, accordingly, there is no reduction division in the Weismannian sense, the term *eumitotic* is applied, since it is the method characteristic of ordinary somatic mitoses. For that method in which one of the chromosome divisions is transverse and the other longitudinal the term *pseudomitotic* is suggested, and this method is subdivided into a method of *postreduction division* in which the so-called reduction division succeeds the equation division and a method of *præreduction division* in which the reduction division is the first to occur. The possibility of a fourth method in which both divisions are reduction divisions is admitted, but it is held that at present its occurrence is not proved.

An excellent section is also that on the maturation of parthenogenetic ova, in which the question of the development of ova with a subnormal number of chromosomes is considered.

As in the preceding instalment of the work the statement of facts is throughout thorough, clear and well arranged, and opportunity is taken to discuss fairly their bearing on general questions, sections of great interest being devoted to the significance of the numerical reduction of the chromosomes in maturation, to sex determination, to the significance of fertilization, and as an appendix there is added an excellent review of the theories of heredity and the allied theories of differentiation.

The figures are throughout well chosen and reproduced and there is an extensive bibliographical list.

J. P. McM.

SCIENTIFIC JOURNALS AND ARTICLES.

The *American Anthropologist* for January–March (Vol. V., No. 1), recently published, contains an exceptionally large number of articles, in addition to the usual book reviews, periodical literature and anthropologic miscellanea. 'The Native Languages of California' are treated, with seven plates, by Drs. Roland B. Dixon and A. L. Kroeber, the classification of these interesting linguistic groups dealing with structural resemblances rather than with definite genetic relationships—the aim being to establish not linguistic families, but types of families. The illustrated article, 'Sheet-Copper from the Mounds is not necessarily of European Origin,' by Mr. Clarence B. Moore, with a discussion by Mr. Joseph D. McGuire and others, is an able presentation of both sides of a long-disputed question in American archeology. Bearing on the same theme is an article by Warren K. Moorehead, 'Are the Hopewell Copper Ob-

jects Prehistoric?' followed by 'Primitive Metal Working,' by C. C. Willoughby. The entire question of aboriginal American copper-working is debated and many new evidences brought out by specialists who have devoted much time to the study of the problem of prehistoric metal-working and in experimental work with primitive appliances. In 'American Indian Games (1902)' Mr. Stewart Culin, the recognized authority on this subject, presents his most recent conclusions. Dr. George Grant MacCurdy reviews the 'Progress in Anthropology at Peabody Museum, Yale University,' during the last few years, describing the field work conducted and the more important collections made. Some 'Parsee Religious Ceremonial Objects in the National Museum' are described, with illustrations, by Dr. I. M. Casanowicz, introducing his paper with a brief account of the Parsees and their religious beliefs. Dr. Frank Russell, in an article on 'Pima Annals,' describes some interesting tally-sticks of the Pimas of Arizona on which are kept mnemonic or pictographic records of events, such as battles or skirmishes, infrequent natural phenomena, relations with white people, festivals, killings during drinking bouts, etc. The four 'annals' described cover the years 1833–4, 1836–7, 1857–8 and 1881–2. Mr. Clark Wissler, in a paper on 'The Growth of Boys,' gives in tabular form a series of correlations for the annual increments, based on some 1,500 annual measurements of about 300 individuals of a private school for boys. Dr. Maurice Fishberg treats of pigmentation among the Jews, continuing from the last number of the journal his discussion of the 'Physical Anthropology of the Jews.' Mr. S. C. Simms describes, with an outline figure, a curious 'Wheel-shaped Stone Monument in Wyoming,' the former use of which is problematical. Mr. George F. Kunz presents a biographic sketch, with an excellent portrait, of the late Heber R. Bishop, and describes the remarkable jade collection which Mr. Bishop presented to the Metropolitan Museum of Art. The proceedings of the meeting of Section H of the American Association for the Advancement of Science, with it affiliated societies, at the Washington meeting, is given by Dr. George Grant MacCurdy, and the number closes with an account of the organization of the American Anthropological Association, with its constitution and a list of the officers and members.

The *American Anthropologist* is now published under the auspices of the new association, of which it is the official organ, as well as that of the Anthropological Society of Washington and the American Ethnological Society of New York.

SOCIETIES AND ACADEMIES.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of April 20, 1903, Professor J. A. Holmes gave an illustrated account of some of the efforts that are being made in the United States to preserve the forests and other natural features of the country, showing what is being done for the preservation of some of the great scenic features and particularly what the national government is doing in the way of national parks and forest reserves and in the protection of the forests on such reservations.

One person was elected to active membership.

At the meeting of May 4, 1903, Mr. H. A. Wheeler gave an account, illustrated by several lantern slides and some of the recently ejected material, of the active Mexican volcano Colima, of which he saw some of the recent eruptions. It was shown that the material now being ejected is a trachyte, or belongs to the acid series of lavas, while the basal plain of the volcano is of basalt, which is basic, resting upon volcanic tufa. It was pointed out that this sequence reverses the Richtofen order of volcanic discharges, from which it was considered probable that there have been other centers of lava outflow besides the now visible vents of Mt. Colima (active) and Mt. Zapotlan (inactive). Samples of the ash from the eruption of February 28, in the form of granules 1 to 2 mm. in diameter, which fell at Túxpan, some twenty-five miles from the crater, and which were secured by Pro-

fessor Trelease, contained 62.5 per cent. of silica, according to the analysis of Mr. W. M. Chauvenet.

An amendment to the by-laws was adopted, providing that the home recently presented to the academy shall not be mortgaged or voluntarily encumbered and shall not be sold except with the consent of two thirds of the members, obtained by letter ballot, and, if sold, the proceeds, or so much thereof as may be necessary, are to be used to provide another home for the academy.

At the meeting of May 18, 1903, Dr. C. Barck gave a detailed account of the Grand Cañon of the Colorado, with lantern illustrations. After an outline of the geology, past and present, of the plateau province and the cañon district, he gave a description of the latter and added a report of its first deliberate crossing. This was made by Mr. James and himself in 1901. They started from Bass's camp, about twenty-four miles west of the Bright Angel Hotel. Their point of destination, 'Point Sublime,' on the northern rim of the cañon, was reached, after some difficult traveling, on the fifth day; the return took three days.

One person was elected to active membership.

William Trelease,
Recording Secretary.

AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION.

The forty-fifth regular meeting of the section was held on Friday, May 22, at 8 P.M., at the Technology Club, Boston, Vice-President Henry Howard in the chair. Thirty-five members were present.

Professor S. W. Stratton, of Washington, D. C., gave an address on 'The National Bureau of Standards,' in which he first gave a historical introduction describing the legal standards of length and weight used in this country from 1776 to 1901, when the National Bureau of Standards was established by act of Congress. The functions of this bureau are briefly the comparison of the standards used in scientific investigation, engineering, manufacturing, commerce and educational institutions with the standards adopted or recognized by the government, the construction when necessary of standards, their multiples and subdivisions, the testing and calibration of standard measuring apparatus, the solution of problems which arise in connection with standards, the determination of physical constants and the properties of materials. The bureau is authorized to exercise its functions for the government of the United States, for state and municipal governments within the United States, for scientific societies, educational institutions, firms, corporations or individuals. Temporary quarters are now occupied by the bureau, and two permanent buildings in the outskirts of Washington are in process of erection, one of which, the mechanical laboratory, is now nearly completed, and will contain the mechanical and electrical plant, instrument shop and laboratories for experimental work or testing requiring considerable power or large currents. The second building is a physical laboratory and will be of extra heavy construction, and will contain laboratories for testing and investigation in connection with problems concerning length, mass and capacity. A large space is to be devoted to electrical measurements of all kinds, and the upper floors are to be used as chemical laboratories. The buildings are connected with a tunnel, part of which will be used as a laboratory for experiments requiring a long distance.

The lecturer described the present work of the bureau in verifying standards of length, mass and capacity, electrical resistance and capacity, electromotive force, photometry, temperature standards, calibration of chemical glassware, etc., and showed several lantern slides of plans of the buildings under construction.

Arthur M. Comey,
Secretary.

MEETING OF THE BERZELIUS SOCIETY.

The eighty-fifth monthly meeting of the Berzelius Chemical Society was held in the Department of Agriculture Laboratory, Monday, May 4. The program was filled by Mr. J. W. White, student in dyeing at the A. &

M. College, and by Dr. B. W. Kilgore, state chemist.

Mr. White read a paper embodying a report of studies made of the sulphur class of dyes, which are to-day the most interesting class of colors with which the cotton dyer has to work. Samples were obtained from Mr. White from all the leading dye-stuff dealers. These samples were submitted to all the different tests corresponding to the tests through which the cotton must pass in actual use, and in all these tests the new class of sulphur colors showed themselves very much superior to the direct cotton colors now in use, and they promise to ultimately replace the dye-stuffs now on the market, and entirely change the method for dying cotton goods with direct dye-stuffs. The paper was illustrated with dyed samples which had been tested to all the different conditions.

Dr. Kilgore filled the program for a short time with a discussion of the recent work of the soil survey in this state. Though the work has not progressed far enough to draw very many conclusions, several very interesting things were noted. In analysis made of soil waters, for plant food, as was to be supposed, it was found that the more leachy sandy soils contained the largest amount of plant food in solution in the third and second foot in depth. It is interesting, however, to note that the same holds with the red clay soils in the Piedmont section of the state.

In the study of the composition of type soils of the state, which work is being carried on by the department, it has been found that lime is present in seemingly unusually small amounts. In the red-clay soils in the Piedmont section of the state, where there were considerable amounts of phosphoric acid, nitrates and potash, analysis revealed scarcely a trace of lime. This would indicate that the soils are in actual need of an application of lime, but of course for definite conclusion this would have to be tested experimentally.

J. S. CATES,
Secretary.

RALEIGH, N. C.,
May 5, 1903.

DISCUSSION AND CORRESPONDENCE.

MOUNT PELEE.

TO THE EDITOR OF SCIENCE: Should not the Martinique volcano be called either *Mont Pelé* or *La Montagne Pelée* or in plain English *Mount Pelee* (no accent)? My impression from a visit to St. Pierre and Morne Rouge in 1895 is that the common name was *La Montagne Pelée* and I understood that *pelée* was an adjective meaning *bare* like the Spanish *pelado,* also applied to bare or woodless hills. I remember that the mountain did not then seem to have any bare surface at all. Of course, if an adjective, the form to go with the masculine *mont* is *pelé* and with the feminine *montagne* is *pelée,* and the combination Mont Pelée is neither French nor English. I am reminded of this now by what seems a complete confirmation in Professor Heilprin's book at page 166, although he calls his work 'Mont Pelée and the Tragedy of Martinique.' Geo. Kennan's 'Tragedy of Pelée' is non-committal and his use of the name always accurate.

In Stark's 'Guide to Barbados and the Caribbee Islands,' Boston, 1893, the form Mt. Pelee (no accent) occurs at p. 42. This I suppose should be read *Mount Pelee* on usual English analogies. The writing of a French accent, however, seems to involve the correct French form of the word.

MARK S. W. JEFFERSON.

THE PROPOSED BIOLOGICAL LABORATORY AT THE TORTUGAS.

TO THE EDITOR OF SCIENCE: Professor Mayer, of the Brooklyn Museum, has asked me to give my opinion on the advisability of establishing a tropical biological station in American waters.

I think that such a station would be an invaluable aid to biological research in all departments, and no one who is acquainted with the rich fauna of the Mediterranean and even of British seas can help regretting the way in which work is hampered by the comparative paucity of life on our northeastern coasts.

West Indian waters would, however, surpass in interest and variety of species the Mediterranean.

It seems to me that a station on one of the Bahama Islands, if possible in a place where some sheltered or lagoon water could be had, would be the situation most to be desiderated.

E. W. MacBride.

McGill University.

SHORTER ARTICLES.

THE FIRST EDITION OF HOLBROOK'S NORTH AMERICAN HERPETOLOGY.

In a 'biographical memoir of John Edwards Holbrook,' prepared for the National Academy of Sciences, and in the compilation of which I took unusual care, I assumed that only three volumes of the first edition of the 'North American Herpetology' had been published. In the 'publisher's note' to the second edition it was, indeed, explicitly stated that 'in consequence of * * * the demand for the *first three volumes* it became necessary either to reprint them or to make a new edition,' and thus by implication it was certified that no later volume of the first edition had been published. With this statement all the many bibliographies and works I had consulted agreed.

I was not a little surprised, therefore, when I received a letter from my friend, Mr. Witmer Stone, informing me that 'the last word' has not been said on the 'Herpetology,' and that there was a fourth volume of the first edition in the library of the Academy of Natural Sciences of Philadelphia. I was led thereby to review numerous bibliographies and works on reptiles and amphibians to ascertain whether any references had been made to a fourth volume which I had previously overlooked. Duméril and Bibron, Baird and Girard, Cope, Garman, Günther, Boulenger, and Stejneger alike made no reference to such a volume. The bibliographies of Agassiz and Strickland, Engelmann, Carus and Engelmann, and catalogues of numerous public libraries were also silent as to the existence of any other than 'the first three volumes.' The British Museum librarians, indeed, knew only one volume; in its great catalogue, 'Vol. I., Philadelphia, 1836. 4°' is listed, and the remark made 'No more published'!

In short, no recent author seems to have known a fourth volume of the first edition, but it occurred to me that Dekay, who was a friend of Holbrook and published his part on the reptiles in the same year (1842) as Holbrook did his second edition, might have done so. On reference to his work, I found he did.

Dekay, in his 'Zoology of New York,' Part III., listed Holbrook's work in his 'List of works referred to' by him (p. vi), as 'North American Herpetology; [etc.] 4 vols. 4to. Philadelphia, 1834 et seq.,' but inasmuch as he referred, in the synonymies of his work, to the second edition, although published in the same year (1842),* this was entirely insufficient. Occasionally, however, he did refer to a volume IV. ('vol. 4') which evidently was not that of the second edition.

Under 'the Snapping Turtle' (p. 8), reference was made to 'vol. 4, p. 21, pl. 3; and vol. 1, p. 139, pl. 23 of the 2d Ed.'

Under 'the Geographic Tortoise,' reference was made to '*Testudo id.* [*i. e., geographica*] Holbrook, N. Am. Herp. Vol. 4, and Vol. 1, p. 99, pl. 14 of Ed. 2da.' This was quite erroneous; Holbrook described his '*Emys pseudogeographica*' in the fourth volume, but not *Emys geographica*, that species having been described in the first volume under the new specific name *Emys megacephala*. Under 'the Pseudographic Tortoise,' as well as all the other Chelonians, reference was only made to the second edition.

Under '*C*[*oluber*] *sayi*' (noticed as extralimital at p. 41) reference was made to 'Vol. 4,' which must have been of the first edition, since in the second edition the species was described in the third volume.

Under 'the Ribbon Snake' (p. 47) reference was made to 'Holbrook, N. A. Herpetology, Vol. 4, p. 21, pl. 4; and Vol. 4, p. 21, pl. 4, of 2d Ed.' Evidently the author had taken up the fourth volume of the second edition twice, for in that of the first, the '*Coluber saurita*' was described on page 87 and figured on plate 16.

The '*C. obsoletus*,' '*C. rhombomaculatus*'

* Dekay probably had proof-sheets and not complete volumes.

and '*C. doliatus*' were bracketed ({) and listed as unpublished '(HOLBROOK, ined.).' Really each of these species was published in 'Vol. III.' of the second edition and Dekay had referred to Holbrook's descriptions of the species which occur on adjoining pages, *i. e.*, *Coluber constrictor* (III., 55, pl. 13, erroneously given by Dekay as 'p. 69, pl. 15') and *Coronella sayi*. The *C. rhombomaculatus* and *C. doliatus* of the first edition were referred to *Coronella* in the second edition.

Under *Salamandra rubra*, reference was made to '*Holbrook*, N. Am. Herpetology, Vol. 4,' without specification of page or plate. In the second edition the species was treated of in the fifth volume.

For all the other species described in the fourth volume, reference was made by Dekay to the second edition only.

With these exceptions, I know of no references to the volume in question.

The subjoined description and summary of the contents of the volume are entirely due to Mr. Stone.

Vol. IV., Philadelphia, J. Dobson, 1840. [4to, title page + blank leaf + introduction [vii]–viii + contents (one leaf) + 9–126 pp., 28 pl.]

	PAGE.	PLATE.
Trionyx ferox	9	1
muticus	17	2
Chelonura serpentina	21	3
Temminckii (n.)	29	4
Chelonia mydas	35	5
caretta	43	6
imbricata	49	7
Emys cumberlandensis (n.)	55	8
pseudographica (n.)	59	9
Coluber getulus	63	10
Sayi	67	11
melanoleucus	71	12
constricta	75	13
eximius	81	14
vernalis	85	15
saurita	87	16
sirtalis	91	17
ordinatus	95	18*
sipedon	99	19
rhombomaculatus (n.)	103	20
leberis	105	21
Bufo quercicus (n.)	109	22
Coluber amœnus	113	23
Crotalus oreganus (n.)	115	29* [=24]
Salamandra cirrigera	119	30 [=25]
quadramaculata (n.)†	121	27 [=26]
rubra	123	27
Haldemani (n.)	125	28

* Misquoted in text VIII. for XVIII.

"Acknowledgements in the introduction are to Dr. Harden, of Georgia; S. S. Haldeman, Dr. Barratt, of South Carolina, for specimens, Mr. Heimans, Miss Martin and Chas Rogers for drawings, and to Dr. Logan for aid.

"The lithographing is by Duval, the drawings by Dr. T. M. Logan (4), A. Heiman (2), J. Queen (4), C. Rogers (3), Stocking (1), J. Sera (5), J. H. Richard (6), Miss Martin (1), Dr. J. L. Smith (1), A. Newsam (1).

"The volume is perfectly uniform with the others."

It will be noticed that Mr. Stone records no less than ten artists as contributors to the plates of the volume. It is quite possible that Holbrook may have become dissatisfied with the results, and for that reason suppressed the volume. His ideals were high, but, unfortunately, his constitutional inertness and forgetfulness interposed to prevent him from realizing his ideals; those ideals, too, were rather the perfection of the artistic than of the literary parts of his work. His later artist, Richard (pronounced Ree-shard), was an Alsatian Frenchman and his work required rigorous supervision. As a matter of gossip, he informed me that he had heard, in Charleston, that Holbrook had spent 'three fortunes' in the preparation and publication of his works. He would become dissatisfied with a work before its completion and would have new plates drawn and published. Then he would offer to substitute the new for the old

* The numbers on the last five plates are badly jumbled; the numbers in the text are all right, however.

† Name accompanying description is '*maculo-quadrata*.' The plate name comes first but *maculo-quadrata* is in the contents at the beginning of the book!

numbers, and, I was told, might even decline to let an old subscriber have a copy of the new edition unless the old one was returned —to be destroyed. If this statement was correct, the rarity of the old volumes would be to some extent at least accounted for.

The discovery of the new volume is interesting chiefly from a historical or bibliographical point of view. The only essential change it will entail is the dating back of the first descriptions of seven species, viz., *Crotalus oreganus* (so spelled), *Coluber couperi, Coluber quadrivittatus, Coluber rhombomaculata, Bufo quercicus, Salamandra quadrimaculata* and *Salamandra haldemani.*

In my biographical memoir I did not consider it necessary to correct or notice numerous misstatements respecting Holbrook's works, but perhaps it may be advisable to refer to one here.

In Engelmann's 'Bibliotheca Historico-naturalis' (p. 172) and in Carus and Engelmann's 'Bibliotheca Zoologica' (p. 134) to 'Holbrook, John Edw.,' is accredited a publication entitled 'Scientific Tracts. 3 Vols. in-12. *Boston* 1831–33 (*London, Wiley and Putnam.*) 18s.'*

John Edwards Holbrook had nothing to do with that serial, the series having been commenced by one Josiah Holbrook in company with other writers. I have been able to see the volumes, which are in the library of congress. The three volumes are composed each of 24 tracts of a monographic nature, the 'terms' being '24 numbers a year, at one dollar and fifty cents, payable in advance.' Volume 1 has such contents as 'The Atmosphere' (numbers 1 and 3), 'Geology' (2), 'Gravitation' (4), 'Animal Mechanism' (5) and the like; one of the coauthors was J. V. C. Smith.

This series was succeeded by a 'new series,' 'conducted by Jerome V. C. Smith, M.D.,' issued in numbers of 32 pages each on the 1st and 15th of each month, miscellaneous in their character, and paged to form two volumes each year. Smith gave up and in 1836 a new volume (apparently the last) of the 'Scientific Tracts' was published by others in 12 semi-monthly numbers of 32 or 24 pages, and, at last, of 16 pages each. Those were the years of tracts, religious, temperance, political, and even 'scientific.'

My thanks for information respecting the volume in question are due and given to Mr. William J. Fox, as well as to Mr. Witmer Stone.

THEO. GILL.

COSMOS CLUB,
April 28.

* The words are quoted from Engelmann (p. 172) and differ slightly from those in Carus and Engelmann.

RECENT ZOOPALEONTOLOGY.

CONCERNING THE ANCESTRY OF THE DOGS.

MR. J. B. HATCHER, in a recent memoir on Oligocene Canidæ, distinguishes three closely allied genera from the White River formation and proposes some very interesting changes in the phylogeny of the family. His observations are based on the very fine specimens of these rare fossils collected by Mr. O. A. Peterson for the Carnegie Museum. These include one complete and three incomplete skeletons, the skulls all well preserved. The thorough and clear description of the skeleton of *Daphænus felinus* is especially valuable as based on a single and very complete specimen. The resemblance of this primitive dog to the contemporary ancestors of sabre-tooth cats has been strongly urged by Professor Scott in his previous description of *Daphænus;* Mr. Hatcher, on the contrary, is impressed less by its feline than by its creodont characters, which he points out at some length.

He distinguishes three closely allied genera among these specimens:

1. *Daphænus,* with elongate skull, high sagittal crests, robust premolars, etc.

2. *Protemnocyon,* gen. nov., with short skull, low sagittal crest and small premolars.

3. *Proamphicyon,* gen nov., with elongate skull, high sagittal crest, small premolars and serrate canines.

(The distinctions between the first two genera are better displayed in the referred species, *D. felinus* Scott and *P. inflatus* Hatcher, than in the typical species *D. vetus* Leidy and *P. hartshornianus* Cope, which, as

shown by skulls in the American Museum, are intermediate forms and quite closely allied. The height of sagittal crest, assigned as one of the distinctive generic features of *Daphœnus*, is a highly variable character in most carnivora, dependent on sex, age and individual robustness. A series of opossum skulls will well illustrate analogous variations, as recently described by Allen. Serrations are to be found on the unworn canines of all daphænoid dogs that I have examined, but disappear very quickly with wear. Canines of old animals are smooth and more rounded in section from wear.)

As the names indicate, Mr. Hatcher believes that *Protemnocyon* is ancestral to *Temnocyon* of the John Day formation, and *Proamphicyon* to *Amphicyon* of the Loup Fork, while *Daphœnus* left no descendant. Scott, Eyerman, and Wortman and Matthew had, on the contrary, derived *Temnocyon* from *Daphœnus*, and all previous authors have regarded *Amphicyon* as a distinctively European type which found its way to America only in the later Miocene.

Mr. Hatcher does not recognize *Mesocyon* Scott (=*Hypotemnodon* Eyerman, type *Temnocyon coryphæus* Cope) as a valid genus, and bases his comparison of *Protemnocyon* with *Temnocyon* upon *T. coryphæus*, and not upon the typical species (*T. altigenis* and *T. ferox*). The authors above mentioned had derived the typical Temnocyons from *Daphœnus* but threw out *Mesocyon coryphæus* from this line of descent.

(Mr. Hatcher can hardly have seen Dr. Eyerman's paper of May, 1896, for he could not fail to observe that the characters assigned to separate *Temnocyon* and *Mesocyon* are identical with those by which he separates *Daphœnus* and *Protemnocyon*, only they are even more marked and certain differences in the teeth are superadded. In the White River there are intermediate species between the two extremes; in the John Day these have not been found. If then *Protemnocyon* is a good genus, *Mesocyon* must certainly be held. If we can assume that the John Day formation is of later age than the White River, it appears probable that *Mesocyon* and *Temnocyon* represent the further progress of the differentiation between the large-skulled robust *Daphœnus* and the small-skulled, more slender *Protemnocyon*. The extremes have become more divergent and the intermediate forms weeded out. The *Daphœnus-Temnocyon* line appears to lead into a type such as *Cyon*, or the dholes, and evidences of an intermediate stage from the Loup Fork Miocene were described by Matthew about a year ago. The *Protemnocyon-Mesocyon* line leads into much more typical dogs, but can not be considered as a direct ancestor of any living species which I have examined.

Mr. Hatcher's derivation of *Amphicyon americanus* from *Proamphicyon* is, I think, hardly admissible. *Amphicyon* first occurs in America in the upper Miocene Loup Fork, but in Europe it is found in the oldest Oligocene formations, as old as or older than the White River. The evidence is not at all such as to warrant our affirming the actual convergence of the Miocene Amphicyons of Europe and America, the one derived from one Oligocene stock, the other from a widely different one. We might, perhaps, believe that *Proamphicyon* and the European Oligocene Amphicyons had a common Eocene ancestor; but as *Proamphicyon* is in fact very much nearer to *Daphœnus* than to *Amphicyon* it seems more reasonable to suppose that the latter is, as Wortman believes, derived from a distinct group of short-jawed dogs of the Middle Eocene.)

Mr. Hatcher makes at the close of his memoir some good-natured criticisms of the views expressed by Wortman and Matthew in 1899 as to the ancestry of certain Canidæ. That such phylogenies are to a high degree hypothetical, and seldom, if ever, more than approximations to the truth, I am most ready to admit—and have always regarded such a saving clause as implied in any phylogenetic remarks. But the new evidence brought forward since then by Wortman and myself, and now by Mr. Hatcher, serves to confirm in most points the very lines of descent which we suggested at that time.

W. D. MATTHEW.

IRON AND STEEL TRADE IN 1902.

The report, now in press, on the iron and steel trade for 1902, by Mr. James M. Swank, United States Geological Survey, shows a continued advance in the annual domestic production of pig iron, the excess over 1901 being 1,942,953 tons, or almost 12.24 per cent. The total production in 1902 was 17,821,307 long tons, as compared wth 15,878,354 tons in 1901, 13,789,242 tons in 1900, 13,620,703 tons in 1899, 11,773,934 tons in 1898, and 9,625,680 tons in 1897.

Notwithstanding this increase of production, the imports of iron and steel in various forms amounted in foreign value in 1902 to $41,468,828, as against $20,395,015 in 1901, an increase in 1902 of $21,073,811, or over 100 per cent. The total exports of iron and steel, including locomotives, car wheels, machinery, etc., amounted in 1902 to $97,892,036, as against $102,534,575 in 1901, $129,633,480 in 1900, $105,690,047 in 1899. The exports of agricultural implements, which are not included above, amounted in 1902 to $17,981,497, against $16,714,308 in 1901.

The consumption of pig iron in 1902 was approximately 18,439,899 long tons, of which 625,383 tons were imported, as compared with 16,232,446 tons in 1901, of which 62,930 tons were imported. The increased production of pig iron in 1902 over 1901 was 1,942,953 tons; the increased consumption was 2,207,453 tons.

At the close of 1902 the number of furnaces in blast was 307, as compared with 266 at the close of 1901 and 232 at the close of 1900. At the close of 1902 105 furnaces were out of blast—many being temporarily banked from lack of fuel—as against 140 furnaces at the close of 1901.

The production of Bessemer steel ingots and castings increased more than half a million tons in 1902—to 9,306,471 long tons; the production of Bessemer steel rails remained almost stationary. The production of open-hearth steel ingots and castings in 1902 was 5,687,729 long tons, an increase of 1,031,420 tons over 1901.

In the fiscal year 1902 there were built for mercantile service 106 steel vessels and one iron vessel, with a gross tonnage of 280,362 tons, as compared with 119 steel vessels and one iron vessel, with a gross tonnage of 196,851 tons, built in 1901. Of these 107 vessels, 49, with a gross tonnage of 161,930 tons, were built at ports on the Great Lakes.

The production of pig iron in Canada in 1902 increased to 319,557 long tons, over 30 per cent. as compared with 1901; and the production of steel ingots and castings in 1902 was 182,037 long tons, as compared with 26,084 tons in 1901, an increase of 155,953 tons, or nearly 600 per cent.

The second part of Mr. Swank's report consists of an interesting and valuable series of tables presenting complete statistics of the production of iron and steel, iron ore, and coal in the United States, Great Britain, Germany, France and Belgium, to the close of 1901, thus showing the progress that has been made by these countries in the first year of the twentieth century.

'FESTSCHRIFT' IN HONOR OF PROFESSOR VAUGHAN.

A committee consisting of John J. Abel, Johns Hopkins University, Baltimore, Md.; Edmund Andrews, Chicago, Ill.; Flemming Carrow, University of Michigan, Ann Arbor, Mich.; Richard Dewey, Wauwatisa, Wisconsin; George Dock, University of Michigan, Ann Arbor, Mich.; William J. Herdman, University of Michigan, Ann Arbor, Mich.; William H. Howell, Johns Hopkins University, Baltimore, Md.; Franklin P. Mall, Johns Hopkins University, Baltimore, Md.; William J. Mayo, Rochester, Minnesota; Lewis S. Pilcher, Brooklyn, New York; Albert B. Prescott, University of Michigan, Ann Arbor, Mich.; Henry Sewall, Denver, Colorado; and G. Carl Huber, secretary, has sent out the following announcement:

The close of the present academic year marks the twenty-fifth anniversary of the doctorate of Doctor Victor C. Vaughan. Certain of the former students of the Department of Medicine and Surgery of the University of Michigan and his colleagues have deemed it opportune to commemorate the long and valuable services which he has rendered to his Alma Mater and to American medi-

cine in general. This expression of appreciation and esteem should be one of permanent value and to the educator and investigator nothing can be more acceptable than the dedication of a volume which contains the researches of friends and co-workers. Such a volume, or Festschrift, is an appropriate honor to the recipient and is itself a valuable contribution to medical science. The suggestion that on this occasion the testimonial should take this form met with the cordial favor and ready approval of the committee. At an early date steps were taken to secure adequate and representative contributions and it will be a source of pleasure and pride to all friends of the movement to know that the project is nearing its realization. The commemorative volume, which will be of about seven hundred pages, is now in press and is expected to be ready for distribution by the end of June.

The price to subscribers, in advance, has been fixed at five dollars for cloth binding, six dollars for half morocco. After publication the price of the volume will be raised.

Subscriptions may be sent to Dr. F. G. Novy or to Mr. George Wahr, publisher, Ann Arbor, Mich.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR J. PETER LESLEY, the eminent geologist, died at Milton, Mass., on June 1, aged eighty-three years.

VICTORIA UNIVERSITY, as part of the celebration at Manchester in commemoration of Dalton's publication of the atomic theory, has conferred the degree of D.Sc. on Professor F. W. Clarke, of Washington, and Professor J. H. Van't Hoff, of Berlin.

THE University of Wales will confer the degree of Doctor of Science on Lord Kelvin 'on the ground of his eminent services to physical science,' and upon Lord Lister, 'on the ground of his long-continued scientific research, which, by establishing a system of antisepsis, has revolutionized the practice of surgery throughout the world.' The degrees will be conferred at a congregation of the university next November at Cardiff.

DR. H. M. REESE, of the Lick Observatory, has accepted an appointment in the Yerkes Observatory. His place at Lick Observatory will be filled by Mr. J. H. Moore, assistant in the department of physics of Johns Hopkins University.

THE German Chemical Society has conferred its gold Hofmann medals on Professor Henri Moissan and Sir William Ramsay.

MR. BION J. ARNOLD has been elected president and Messrs. Calvin W. Rice, W. S. Barstow and Ralph D. Mershon, vice-presidents of the American Institute of Electrical Engineers.

MR. HENRY L. WARD has been elected custodian of the Milwaukee Public Museum for a period of five years.

DR. W. J. HOLLAND, the director of the Carnegie Museum, Pittsburgh, gave the commencement address before the University of North Carolina at Chapel Hill on June 3.

PROFESSOR HUGO MÜNSTERBERG, of Harvard University, sailed on May 30 for Germany, where he will represent the St. Louis Exposition in an effort to secure the cooperation of the German government and educational institutions in the International Congress of Arts and Sciences to be held in connection with the exposition next year. Professor Albion W. Small, of the University of Chicago, will undertake a similar mission to France. Professor Simon Newcomb, chairman of the committee, is also abroad, partly in the interests of the congress.

PROFESSOR W. F. WILLCOX, of Cornell University, has been requested by the director of the census to prepare a report on the census work of other countries, and will spend the present summer in Europe.

PROFESSOR C. S. SARGENT, director of the Arnold Arboretum, accompanied by his son, Mr. A. R. Sargent, and Dr. John Muir sailed for Europe on May 29. After traveling through France, Holland and Germany the botanists will go to St. Petersburg and Moscow, and thence over the Transsiberian Railway to Pekin. They will make numerous stops on the way to collect seed and herbarium specimens in Siberia and northern China. From Pekin they will go to Java and Hong Kong.

Dr. Barton Warren Evermann, for several years ichthyologist of the U. S. Fish Commission, and assistant in charge, Division of Fisheries, since November, 1902, has been promoted to the position of assistant in charge, Division of Scientific Inquiry of the U. S. Fish Commission. On June 13 he sails on the *Albatross* from Seattle for Alaska, where, as assistant head of the special Alaska Salmon Commission, he will spend the summer making an investigation of the salmon fisheries of that coast.

The Earl of Onslow has been appointed president of the Board of Agriculture for Great Britain.

The subject of the Romanes lecture, which is to be delivered by Sir Oliver Lodge, F.R.S., at Oxford, on June 12, will be 'Modern Views on Matter.'

Professor George E. Beyer, of the department of biology and natural history at Tulane University, has gone to Vera Cruz, Mexico, to continue his studies on yellow fever.

Mr. J. A. Shafer, custodian of the botanical collections at the Carnegie Museum, who went to Cuba with Dr. N. L. Britton some months ago, has returned. He remained on the island after Dr. Britton's departure for the north in order to prosecute further researches. As the result of the joint labors of Dr. Britton and Mr. Shafer the herbaria at Bronx Park and Pittsburgh have each received over one thousand species of the plants of Cuba in fresh condition.

The Berlin Geographical Society celebrated on May 4 its seventy-fifth anniversary. In honor of the seventieth birthday of Professor von Richthofen the sum of 26,000 Marks has been subscribed as a fund for research. The society has awarded its Nachtigall medal to Dr. Gerhard Scholt, of Hamburg.

Lieut. C. J. Shackelton, who was one of the officers of the British Antarctic Expedition, is at present in the United States on his way from New Zealand to England.

Syracuse University has appointed Professor H. Monmouth Smith delegate to the Congress of Applied Chemistry at Berlin and granted him leave of absence till fall. Dr. H. C. Cooper of the same university has also been granted leave of absence that he may work for a year as research associate in physical chemistry at the Massachusetts Institute of Technology. Mr. Charles S. Bryan, Jr., Ph.B., Syracuse, has been appointed research assistant to Professor A. A. Noyes of the Massachusetts Institute of Technology.

M. A. Lebeuf, lecturer in astronomy in the University of Montpelier, has been appointed director of the Observatory at Bescançon.

It is stated in *Nature* that steps have been taken to secure and erect a memorial of the late Sir George Stokes in Westminster Abbey. At a meeting of a joint committee of the University of Cambridge and the Royal Society, held on March 12, the Duke of Devonshire being in the chair, it was resolved that the authority of the Dean and Chapter of Westminster be requested to place a medallion relief portrait of Sir George Stokes in the Abbey of the same general character as the memorials of Darwin and other scientific men already there. A letter has since been received from the Dean of Westminster expressing his general assent to the proposal and his willingness to take detailed plans into consideration. Mr. Hamo Thornycroft, R.A., has undertaken to prepare a medallion, the material to be bronze, and the head to be in high relief. It is estimated that the cost of placing this memorial in Westminster Abbey will be about £400. The treasurers of the fund are the vice-chancellor of the University of Cambridge and the treasurer of the Royal Society, to whom subscriptions may be sent.

Dr. Thomas Jay Hudson, for some years principal examiner in the U. S. Patent Office and the author of a number of books of a psychological character, has died at Detroit.

Mr. Henry J. Woodman, a natural history collector, has died at Mount Vernon, N. Y.

The death is announced of Dr. Max Westermayer, professor of botany at Freiburg, Switzerland, and of Dr. H. Schurtz, assistant in ethnography in the museum at Breman.

MR. WILLIAM TALBOT AVILINE, for many years engaged on the Geological Survey of Great Britain, died on May 12, at the age of eighty-one years.

A TELEGRAM has been received at the Harvard College Observatory from Professor Percival Lowell, at Flagstaff, Arizona, stating that a large projection on Mars was found by Slipper, May 26, at $15^h 35^m$ Greenwich mean time. The position angle was 200° and the projection lasted thirty-five minutes.

THE expedition organized for a scientific survey of the Bahama Islands by the Geographical Society of Baltimore, to which we have already referred, left Baltimore on June 1. It is under the direction of Dr. G. B. Shattuck and includes more than twenty members.

As the result of an expedition to Florida during the spring the Carnegie Museum has added to its ornithological collections over 1,300 specimens in fine condition.

THE anniversary dinner of the Royal Geographical Society was held on May 18. The president, Sir Clements Markham, proposed the toast of 'The Medallists,' to which Mr. Douglas Freshfield and Dr. Sven Hedin responded. The president next proposed 'Success to the Antarctic Expedition.' Major L. Darwin proposed 'The Guests,' and Sir W. Huggins and Mr. Pember Reeves responded. The president then gave 'The Staff,' and the secretary (Dr. J. S. Keltie) replied. Mr. E. Gosse proposed the last toast, 'The President and the Society,' to which the president replied.

ACCORDING to a cablegram to the daily papers Premier Balfour announced in the House of Commons on May 26 that the government was prepared to contribute to the relief of the officers and men of the Antarctic steamer *Discovery,* now icebound in the Antarctic region. At the same time, the Premier criticized the action of the Royal Geographical Society and the Royal Society in sending out the expedition without being fully prepared to safeguard it, and said that even the limited aid the government was accustomed to give to scientific research was only justified so long as the government felt absolute confidence that the scientific bodies inviting help had given all the information regarding the cost and limits of the proposed action. That confidence had been rudely shaken in the present case.

A STOCKHOLM correspondent writes to the London *Times* on May 19: Serious uneasiness has arisen here about the fate of Dr. Nordenskiöld's expedition on board the *Antarctic.* Contrary to expectation, the ship has not yet returned to South America. She had not a very large stock of provisions on board, and it is feared that a second winter out might prove disastrous, as the ship's company consists of 27 men all told, one Argentine officer being among them. A plan for a relief expedition under the command of Lieutenant Gyldén of the Swedish Navy, who has previouly conducted an expedition to Spitzbergen, has just been formed; 50,000 crowns have been collected by private subscription, and the Riksdag to-day granted 200,000 crowns for the expedition, which is to start towards the end of August next. The Argentine Government has offered its cooperation.

FOREIGN journals announce that a Norwegian expedition, commanded by Captain Roald Amundsen, has left Christiania with the object of fixing the exact situation of the magnetic North Pole. The party are expected to be absent for four years, the route taken being by Lancaster Sound, Boothia Felix, where a magnetic observatory will be established for a period of two years under control of two members of the scientific staff, and back by the North-West Passage, Victoria Land and the Behring Straits.

THE executors of the late Mr. Reyner Hurrell have made a donation of £500 to the funds of the Brown Animal Sanatory Institution, London.

THE following committee of organization for the United States, for the Eleventh International Congress of Hygiene and Demography, to be held in Brussels, September 2–8, 1903, has been appointed, at the request of the Belgian government, by the State Depart-

ment: Dr. E. A. de Schweinitz, the Columbian University, Washington, D. C.; Dr. A. B. Richardson, the Columbian University, Washington, D. C.; Dr. John Marshall, University of Pennsylvania, Philadelphia, Pa.; Dr. C. Harrington, professor of hygiene, Harvard University, Boston, Mass. The committee desires to secure the cooperation of all those in this country who are engaged in hygienic work, both in attendance at the meeting in Brussels, and in sending papers to the congress. The congress will be divided into two sections, hygiene and demography. The subjects which will be considered are the relation of bacteria and parasites to hygiene, the hygiene of foods, the treatment and prevention of communicable diseases, etc. The important subject in its various phases of the communicability of tuberculosis will be discussed by prominent men. The fee for membership is 25 francs, which may be sent to the Secretary-General, M. le Dr. Felix Pulseys, Rue Forgeur, l. à Liège, Belgium. Those proposing to attend or send papers will please notify E. A. de Schweinitz, Washington, D. C.

A testimonial signed by over 500 fellows of the Zoological Society of London has been presented to Mr. W. L. Sclater. It reads as follows:

We, the undersigned, Fellows of the Zoological Society of London, desire to place on record our appreciation of the merits of Mr. William Lutley Sclater and of his conduct in the recent contest for the secretaryship of the society. Mr. Sclater was summoned from Cape Town last January to undertake the duties of secretary, and, although he had some warning that opposition might be expected, he could not have foreseen that, in addition to his arduous duties as secretary, he would have had to face a campaign of an unusual kind or be involved, through no fault of his own, in a position with which we greatly sympathize. Throughout the recent trying circumstances Mr. Sclater has acted with dignity and reserve which may in some measure have sacrificed his own interests, but which place him all the higher in our estimation. We believe that his scientific attainments, high character, and proved ability would have fully satisfied the claims of the position to which he had been provisionally elected, and we can assure him that in returning to Cape Town he adds to those qualities the respect and esteem of a wide circle of new friends.

The *Geographical Magazine* learns from the report of the last meeting of the board of directors of the Siberian Railway that the main line is now completed permanently except for the portion circling Lake Baikal, which it is hoped will be finished by the close of 1904. The total cost of the line, including the Baikal section, amounted to nearly 385,000,000 roubles. The number of immigrants who have had grants of land allotted to them is 611,494, and for colonization purposes a sum of 30,000,000 roubles has been assigned. To facilitate the acquisition of agricultural implements and seeds, etc., twenty-nine depots have been established. Arrangements have been made for an efficient prospecting of the country in the neighborhood of the railway, with the view to the development of its mineral resources, and these have already led to the discovery of oil in the vicinity of Sudjenka, in central Siberia, and near Cheremkhovskoje, in the province of Irkutsk. A special grant has also been made for the encouragement of gold prospecting, and an investigation of the Yenesei and Obi has revealed the fact that these rivers are navigable for ocean steamers for a distance of nearly 1,000 miles.

Nature notes a great improvement in the appearance and instructiveness of the exhibits in the reptile and fish galleries of the British Museum of Natural History, which were left at the death of Sir W. H. Flower in their original condition. Until the director undertook the rearrangement, the cases were crammed with a number of faded and 'khaki'-colored specimens, unaccompanied by any descriptive labels. The duplicate and superfluous specimens have now, for the most part, been weeded out, and those that are left placed so that they can be well seen by visitors. In many instances old specimens have either been replaced by new ones or have been painted up so as to give them, so far as possible, some sort of resemblance to the living animals; and this process of replacement and renovation is being actively continued. A large

specimen of thunny which has been for many years in the museum affords an excellent example of what can be done by judicious painting. The splendid coloring of the Malay python is displayed in a specimen presented by Mr. Rothschild, as well as by a second example, on which an artist was still engaged at the time when this was written. In the reptile gallery, which is in the more forward condition, descriptive labels have already been placed in several of the cases, in which the specimens have been removed from the old hideous sycamore stands and set on sanded ground-work.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Legislature of Michigan has passed a bill appropriating $171,900 for the Michigan College of Mines at Houghton for the biennium beginning July 1 next. The largest item is one of $45,000 for the construction of a metallurgical laboratory.

MR. JAMES STILLMAN, of New York, has given $50,000 to establish a contagious disease ward in Stillman Infirmary, which he founded a year ago at Harvard University.

MR. FREDERICK F. AYER has added $50,000 to the $100,000 that he had already given to the Lowell Textile School.

DR. BARTON W. EVERMANN, ichthyologist of the United States Fish Commission, has just returned to Washington from Axton, New York, where he gave a course of twenty-five lectures on 'Fish Culture' and 'Fish and Game Protection' to the juniors and seniors of the New York College of Forestry of Cornell University. The class this year consisted of twenty-two students and is the largest in the history of the college. This course is intended, first, to interest those who are to become foresters in the lakes and streams of the forest, that they may be saved from pollution to the injury of the fishes which inhabit them; and second, to give the students some acquaintance with the mammals, birds, and other animals of the forest, their value, and the necessity for the preservation of those which are not noxious. In addition to the formal lectures, the students were taken on daily excursions for field observations.

THE Massachusetts Institute of Technology, assisted by several gifts made for the purpose, has established a laboratory of physical chemistry to be opened in September, 1903, which is to be devoted exclusively to research work in that important subject. The laboratory is to be under the directorship of Professor Arthur A. Noyes, with whom will be associated Professors H. M. Goodwin and Willis R. Whitney. The researches will be carried on in large part by a staff of research assistants and associates working under their direction. Every facility will also be offered to advanced students who wish to carry on investigations in this branch of science, either with or without reference to an advanced degree. The research laboratory is to occupy one floor of a new building now being erected for the purpose. It will consist mainly of a series of small laboratories, each of which will afford ample accommodation for two workers, and a well-equipped shop in which a skilled instrument-maker will be regularly employed in making and repairing apparatus for investigation work. Rooms for special purposes—weighing, photographic work, glass-blowing, pure-water distillation, storage of chemical and physical apparatus, and the holding of lectures and seminar meetings—will adjoin the laboratories. The members of the laboratory staff will offer a number of advanced lecture courses and will conduct several seminars on physico-chemical subjects which will be open to all those connected with the laboratory. An announcement of these courses is made in the program of the Research Laboratory issued by the institute.

AT a meeting on May 18 of the Court of Governors of University College, Sheffield, the Duke of Norfolk presiding, resolutions were adopted to the effect that in the interests of higher education in the city and district it was essential that Sheffield College should have the powers and *status* of a university similar to those granted to Birmingham, Liverpool and Manchester, and also that application should be made to the Privy Council for a charter.

The report of the Mathematical Pass Examinations Syndicate, at Cambridge University, appointed in December, 1902, has been issued, dealing with the mathematical subjects of the previous examination. According to the London *Times* the report makes important recommendations as regards the treatment of geometry. Hitherto Euclid's elements has been the universal text-book, and Euclid's sequences, if not his actual proofs, have been insisted on. Should the senate accept this report, all this will be changed. In the proofs of theorems any proof which forms part of a systematic treatment of the subject will be accepted, so that teachers will be free to use any text-books. As most of the theorems in the schedule to the syndicate's report are to be found in Euclid, many teachers will no doubt adhere to the old method. Another novelty in the schedule is the introduction of questions in practical geometry involving the use of mathematical instruments. For some years changes more or less of this character have been recommended by a committee of the Mathematical Association and a committee of the British Association. With regard to arithmetic, there will not be required a knowledge of recurring decimals and of the process of extracting cube root, but the use of algebraical symbols and processes will be permitted. These changes are unanimously approved of by a very strong syndicate, consisting of the leading resident mathematicians —viz., Mr. Charles Smith, Master of Sidney, Professor Forsyth, Dr. Hobson, Mr. Mollison, Mr. C. A. E. Pollock, Mr. Welsh, Mr. G. B. Mathews, Mr. S. Barnard, Mr. W. M. Coates, Mr. E. T. Whittaker and Mr. A. W. Siddons. It is proposed that the first examination under the new regulations should be held in December, 1904. The proposal as to algebra is not approved by Mr. Coates. At a meeting of the members of the senate, there was almost entire unanimity in favor of the recommendations, the criticism being confined to points of detail. Some of the suggestions will probably be accepted, but the acceptance of the report by the senate is practically assured.

The question of the expediency of maintaining the Engineering College at Coopers Hill, as a government institution for the supply of officers to the Public Works Department in India, having again been raised, the Secretary of State for India has appointed a committee to inquire and report to him on this subject. It will be composed as follows: Sir Charles Crosthwaite, late Lieutenant-Governor of the North-Western Provinces and member of the Council of India, chairman; Sir James Mackay, G.C.M.G., Sir William Arrol, M.P., Sir Arthur Rücker, principal of the University of London, and Sir Thomas Higham, K.C.I.E., late of the Indian Public Works Department, with Mr. J. E. Ferard, of the India Office, as secretary.

Washington University is extending its teaching force for the coming year by adding an instructor in mathematics, and a professor of psychology and pedagogy.

Dr. John Gordon, president of Tabor College, has received an offer of the presidency of Howard University, at Washington, D. C.

Dr. L. A. Parsons, of the Johns Hopkins University, has been appointed assistant in physics at the University of Utah.

Dr. S. M. Coulter has been promoted from instructor to assistant professor in the Shaw School of Botany in Washington University, and has been given an additional assistant.

Mr. Lewis A. Darling, of the University of Nevada, has been appointed instructor in mechanical engineering in Stanford University and will take part of the mechanical engineering work of Professor G. H. Marx, who goes to Europe on a year's leave of absence.

Dr. George Walter Stewart, instructor in physics at Cornell University, has been appointed assistant professor of physics in charge of the department at the University of North Dakota.

Dr. Philip Henry Pye-Smith, M.D., F.R.S., has been appointed vice-chancellor of the University of London for the remainder of the year for which Dr. Robertson (now Bishop of Exeter) was appointed in June, 1902.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 12, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION I., ECONOMIC AND SOCIAL SCIENCE.

II.

Is an Ideal Money Attainable? CHARLES A. CONANT, Treasurer of the Morton Trust Company, New York city.

Mr. Conant discussed some of the projects for doing away with money which have been put forward from time to time by students, and rejected them upon the ground that they ignore the true function of gold as a store of value and the most exchangeable of commodities. He declared that while large transactions could be cleared against each other without the use of gold, yet in the long run gold must be employed as the final test of value, because it was the one thing desired above all other things because it could always be exchanged for other things. Other things fluctuated in value according to their degree of exchangeability. This degree of exchangeability fell greatly where there was overproduction of goods, and it would be futile and unjust to take the values of goods, even over an average of time, as a proper measure of values. Gold money was the touch-stone of the need for goods. If they rose in price in gold it was an indication of unsatisfied demand; if they fell in gold it was an indication of overpro-

duction. Hence, the exchange value of gold in relation to each other thing was the governor of production and determined the direction in which capital should be employed. It would deprive society of any accurate means of determining the proper direction of capital, and the necessity for increasing or decreasing production of given articles, if it should be attempted to replace gold by a system of averages intended to give uniformity to prices without regard to the relation of demand and supply between different classes of goods.

Cooperation, Coercion and Competition: Professor Lindley M. Keasbey, Bryn Mawr College.

Industrial organization is determined by two factors, by the character of the social surplus, and by the monopolization of the sources thereof. History shows us three characteristic systems of industrial organization—the cooperative, the coercive and the competitive—which have succeeded each other in the order named. In the natural state before the appropriation of natural resources for pastoral and agricultural purposes, the cooperative system prevailed; during the proprietary period which followed, when natural resources were appropriated, but before the institution of exchange, the cooperative system became subservient to the coercive system, while with the rise of the commercial era, resulting from the development of exchange, the coercive system was superseded for some time by the competitive system. Present tendencies appear to point to a reversal of the original order of this succession. Owing to the gradual monopolization of the sources of the industrial surplus by the great capitalists, the older competitive system is breaking down. In its place the coercive system is being reestablished. But coercion when applied stimulates cooperation. The laborers are combining to resist the coercion of organized capital. If, as seems likely, capitalists and laborers cooperate in profit-sharing undertakings, then the consumers may possibly be coerced by the producers. It will then be necessary for the consumers to cooperate. Or to put the general thought theoretically, we may expect the present monopolization of the surplus sources to be extended gradually to admit laborers as well as capitalists, and finally, perhaps, some monopolies to be still further extended so as to admit consumers as well as producers.

Economic Work of the Weather Bureau: Professor Willis L. Moore, chief of Bureau.

In connection with the economic worth of the Weather Bureau the question is often asked, 'Does it pay?' I will cite a few facts in answer to that question.

The first year of the weather service the annual appropriation was about $20,000. This year that appropriation is $1,250,000, and congress and the people are plainly well satisfied with its expenditure. Our daily survey of the atmosphere is the largest attempted by any country or organization, and our system for the dissemination of warnings of severe or injurious weather conditions, such as storms, hurricanes, cold waves, frosts, floods, heavy rains and snows, is so complete that these conditions seldom occur without the country being notified well in advance. To give you some idea of the value of the storm warning service alone, I may say that there are 6,000 sailing vessels and as many steamers engaged in the trans-Atlantic trade, which leave our ports in a given year, and 17,000 sailing vessels and 4,000 steamers which annually ply between the ports on the Atlantic coast. Marine insurance people estimate that one West Indian hurricane, if it

were to sweep up the Atlantic coast unannounced, would leave wreckage to the amount of $2,000,000, without considering the loss of life. There has not been a storm of marked violence along the coast in the past eight years warnings for which were not issued from eight to twenty-four hours in advance of its approach.

Warnings of floods in the river valleys of the United States are also of great value. In the great flood of 1897 in the lower Mississippi valley, warnings were distributed over the inundated districts four to five days in advance of the flood, with the result that almost all of the movable property was taken to higher ground and saved. It is estimated that $7,000,000 worth of property was removed from the Yazoo valley alone on this occasion.

Warnings of those sudden temperature changes known as cold waves are of great importance. In January, 1896, a cold wave of exceptional severity swept over nearly the entire country east of the Rocky Mountains. Warnings of its approach were sent to nearly every weather bureau station in that region from twelve to twenty-four hours in advance. Information gathered systematically from shippers of perishable products and other interests affected disclosed the fact that the warnings resulted in the saving of over $5,500,000 in the protection of property from injury or destruction.

The frost warnings recently issued for Florida, when the temperature in the northern part of the state fell as low as 20° to 24°, and frost formed as far south as Tampa, resulted in the probable saving of hundreds of thousands of dollars to the truck interests of that state.

These are but a few instances of property and money values saved, and they give a very incomplete idea of the full economic value of the Weather Bureau forecasts and warnings to the interests of the country. The work of the bureau in the collection and publication of data and the issue of forecasts and warnings affects the daily life of the people to a very great extent, and becomes an important factor in their various avocations and business enterprises.

Economic Work of the Bureau of Animal Industry: Dr. D. E. SALMON, chief of Bureau.

The Bureau of Animal Industry is required by its organic act "to investigate and report upon the condition of the domestic animals of the United States, their protection and use, and also inquire into and report the causes of contagious, infectious and communicable diseases among them, and the means for the prevention and cure of the same, and to collect such information on the subjects as shall be valuable to the agricultural and commercial interests of the country."

Since the organization of the bureau, however, it has been given from time to time a great amount of executive work, and this now largely exceeds the investigations which constituted the original object of its establishment. Thus it is expected to control and stamp out the contagious diseases of animals which are dangerous to interstate or foreign commerce; to prevent the introduction of diseases from foreign countries by an inspection and quarantine of imported animals; to inspect and certify to the healthfulness of exported animals; to supervise and control the fittings of steamships which carry our animals to foreign countries; to inspect the meat slaughtered for interstate or foreign commerce; and to inspect and certify to the quality of dairy products that are exported.

This brief summary will give an idea of the scope of the duties of this bureau under existing laws.

The first great task was to establish what is known as the Texas-fever line, which now extends from ocean to ocean and serves to divide the section of the country in which the disease originates from that in which its ravages are usually seen. This line needs constant rigid supervision to prevent the spread of the infection. It involved last year the inspection of 1,545,000 cattle and the cleaning and disinfection of 46,736 railroad cars.

The wisdom of establishing the bureau is attested by the successful eradication of the contagious pleuro-pneumonia of cattle from this country, at a comparatively small expense; by the development of a single vaccine for blackleg, which has been used upon millions of cattle and has reduced the losses in infected herds of cattle to less than one per cent., thus saving many millions of dollars to the cattle industry; by the development of a federal meat-inspection service which last year inspected at the time of slaughter 38,829,439 carcasses, insuring healthy meat to domestic consumers and enabling the government to certify to the wholesomeness of that which is exported; by its successful control over the exportation of live animals, a trade embracing 300,000 to 400,000 cattle and 200,000 sheep a year, and which has done away with all unnecessary suffering aboard ship and reduced the losses to 0.13 per cent. with cattle and 0.89 per cent. with sheep; by the successful investigation of many diseases and the dissemination of a vast amount of information relative to the breeding and management of domesticated animals in health and disease.

These are only the principal lines of work undertaken. Every outbreak of disease which is supposed to be contagious is promptly investigated, and in case any are found dangerous to the animal industry of the country the proper measures are applied. Scientific researches are constantly conducted and are throwing new light on the nature of diseases and the means applicable for their control. The objections raised in other countries to our animals or animal products are carefully watched, and the causes removed when well founded, or explained when they are brought with a misunderstanding of the facts.

Economic Work of the Bureau of Plant Industry: Professor B. T. Galloway, chief of bureau.

The organization of the Bureau of Plant Industry was first described. It was pointed out that the general policy of the bureau is to give the broadest opportunities to its individual workers, recognizing the fact that the best results can be accomplished by giving to each individual such responsibilities as will lead to the strongest development of both the man and the work. The bureau's work is handled by problems rather than by groups of subjects. It was pointed out that while the object of the bureau's work is practical in all things, the policy is to encourage scientific research in every way, it being recognized that scientific investigation is the basis for all applied work. The work of the more important branches of the bureau were then briefly reviewed. Examples of the methods of handling plant diseases were given, showing the relation of laboratory research to the securing of practical results in the field. Various methods of handling diseases of crops were described. Treatments by direct remedial measures were discussed; treatments, or preventions, by the securing or creation of immune sorts, were described, and the other methods followed in this line of work were brought out. The work in physiology was described, especial attention being given to the results obtained in the laboratory investigations on nitrifying organisms. The

economic bearing of the plant-breeding investigation was shown. The efforts being made to increase the protein content of corn, and the creation of new varieties of corn for special purposes, were described in detail. Some of the new creations in the matter of fruits were also discussed. The work of the bureau in the matter of foreign explorations for the purpose of securing new plants for use in this country was described. Finally there was given an outline of some of the important work of the botanists in the matter of investigating poisonous plants, and the results accomplished in finding antidotes where the injuries to stock, through the eating of such plants, had proved serious.

Economic Work of the Bureau of Chemistry: Dr. H. W. WILEY, chief of bureau.

The science of chemistry is the first mentioned in the organic act creating the Department of Agriculture. Chemistry, botany and entomology were the three fundamental scientific divisions recognized in the establishment of the department. And the chemist was the first man appointed to investigate the economic problems relative to agriculture in which chemistry is concerned. I will try to give you some idea of the extent and character of this work. In 1886 as vice-president of Section C at Buffalo I gave an address on 'The Economic Aspects of Agricultural Chemistry.' So you have on the records of this association what I have to say on the subject. There has been little change, and I can only offer illustrations and use data not then available. In the first place, chemistry has established the principles of scientific crop feeding. The business of fertilizing in this country has grown enormously. Until twenty-five years ago fertilizing was altogether empirical. When a farmer had any fertilizer to use he spread it all over his fields and used the same kind for all parts of his farm. The patches which yielded the poorest were of course most treated. He had no idea of what was needed or how it should be used. When commercial fertilizers came into vogue many were of poor character and some farmers were rather badly cheated. However, the general effect was good and lands in almost every state in the union have increased in value in consequence of the adoption of the principles laid down by agricultural chemistry. Much better results may yet be obtained when the needs of the soil and plant life are given more attention by the farmer. The researches of agriculture in plant life show often that only certain elements essential to plant growth are lacking in a particular soil, and that others, not always present elsewhere, can be found here in abundance, so that some constituents of the ordinary fertilizer may be left out and others should be present in even greater quantities. It is not necessary to supply a complete fertilizer for each field. The needs of the field should be determined beforehand, and this the agricultural chemist is doing. The great problem is not only how to conserve fertility, but how to increase it when it has been diminished. There is no reason to believe that there will be any reduction in the ratio of the food supply to the population. The former will increase as rapidly as the latter. I might refer to the address of Sir William Crookes a few years ago before the British Association for the Advancement of Science, in which he looked forward to a period about thirty years hence, when humanity would begin to suffer very seriously from a lack of land of the proper productive capacity to feed all of us, until finally there would not be enough food to go around. There is no

longer ground for such fears. The productiveness of the soil will keep pace with the increase of population. When it is necessary to produce 1,000,000,000 bushels of wheat annually in this country it will be forthcoming. The part of the doctrines of Malthus which holds that the food supply can not be made sufficient to maintain the increasing population as the years go by, in my opinion, is absolutely groundless. The food supply will always be sufficient, but that supply must depend largely upon the researches of agricultural chemistry. The farmer to-day can prepare steers for the market at one third less cost than he could twenty-five years ago, because he knows how to balance the rations in the right proportions. He also knows how to bring his stock into the market at an earlier period and thus effect another great saving. The cost of feeding farm animals to-day is only about two thirds what it would be had not the principles of science been applied to raising stock on the farm. After a while perhaps we will be able to study the scientific feeding of man. He is an animal too, you know. If we want a man to be an athlete we feed him in a certain way, and so the time is not far distant when we must learn to feed all kinds of men for the markets just as we do the other animals. And so economy will come in the feeding of men as well as in the feeding of what we are pleased to call the lower animals. We shall save at least one third and shall still have as much as is good for us.

Here is another way in which the principles of agricultural chemistry will prove of economical value. I refer to the idea of securing elements necessary for the growth of the plant from the nitrogen in the air. It has been suggested that the nitrogenous material now in the soil is insufficient for a very great period. But it may be augmented yearly by the floods of which Professor Moore has spoken, by damming rivers, etc., and the use of water power thus secured for converting the nitrogen of the air into forms available for plant nutrition, by electrical means. This, with the nitrogen already available, is more than enough for present and future needs. With a sufficient food supply for the present we can look with complacency upon our rapidly increasing population, and rely on agricultural chemistry for all additional food needed.

Economic Work of the Bureau of Soils: Professor Milton Whitney, chief of bureau.

The Bureau of Soils of the United States Department of Agriculture was organized as a part of the Weather Bureau about eight years ago. Since its organization it has been separated from the Weather Bureau and reorganized into an independent division, and later into a bureau, its rapid growth in size, scope and efficiency having been remarkable. One of its most important lines of work is the soil survey which, while not in itself immediately productive, really constitutes a more intelligent basis for the development of other economic work in agriculture than has hitherto been available. In the strenuous competition for agricultural supremacy existing between different countries, states and individuals, a thorough knowledge of all factors bearing on agriculture is essential. The soil is one of these factors, just as climate, insects and plant diseases are others.

As an illustration of the economic value of the soil survey work may be mentioned the introduction of Sumatra tobacco in the Connecticut valley. A soil survey made in that valley in 1899, showing the distribution of the different soils, disclosed a soil producing a leaf which was the closest approach to the Sumatra wrapper. While

the Connecticut tobacco then brought an average of twenty cents per pound, the imported leaf commanded from $2.50 to $5 per pound. By growing Sumatra seed under cheesecloth tents, erected at a height of nine feet over the entire field, this covering modifying the climatic conditions, and with radical changes in the methods of cultivation and fermentation, a wrapper leaf has been produced equal at least in all respects to the imported article. This past season 700 acres have been grown, the product of which is valued at $1,000,000, bringing on an average from $1.50 to $3 per pound, compared with twenty cents per pound for the ordinary Connecticut wrapper; and an industry has been established which will pay 100 per cent. and over on the investment. Capital is attracted by reason of the fact that a large expenditure can be made on a small area with large returns, or on a larger area with proportionally large profits. An expenditure of $650 per acre yields a return of 100 per cent. or more over and above all expenses. This is a productive industry that has been developed by the bureau, and which is attracting the investment of enormous sums of money.

Another illustration is in the discovery of a soil in Texas which will produce a leaf possessing all the desirable qualities and aroma of the Cuban product. These lands are entirely undeveloped, principally uncleared and practically valueless for other crops, yet tests of the leaf produced, made by experts, show it to be far superior to any of our domestic filler tobacco.

A soil survey made in the Yazoo delta, Mississippi, has brought attention to a soil which, covering enormous areas, has heretofore been regarded as absolutely worthless, but which with a slight expenditure for protection from overflow would produce from $200 to $1,000 per acre, being particularly adapted, by reason of fertility and climatic and market facilities, to trucking.

Another line that has been productive of useful results has been the study of alkali soils of the west. It has been thoroughly demonstrated by practical experiments of the bureau that excessive alkali may be removed by drainage, and thousands of acres of land now worthless may be reclaimed and made productive. A careful study and practical experiments are now in progress, and already the success achieved has thoroughly demonstrated the success of these operations.

Economic Work of the Office of Experiment Stations: Dr. A. C. TRUE, director, Office of Experiment Stations.

This office is so related to the agricultural colleges and experiment stations as to constitute a general agency for the promotion of agricultural education and research. On the economic side, the agricultural colleges, chiefly through their research departments called experiment stations, are doing a large and successful work directly for the improvement of agriculture, by increasing the amount of production and at the same time raising its quality through the application of science to agriculture. But it is on its social or educational side that the experiment station movement is destined to exert its most profound and permanent influence. For the scientific researches of the stations and their application to agricultural practice not only provide much material for effective courses of instruction in the theory and art of agriculture, but they also furnish to the farmer the hitherto lacking motive for definite technical education along the lines of his art. This is changing the intellectual attitude of the farmer from conservatism to progressiveness. If, as now seems likely, the stations and the Department of Agriculture shall erelong succeed in arousing the mass of

farmers to a progressive attitude of mind, and put the center of interest of the vast and fundamental industry, agriculture, in the future, they will accomplish a work of incalculable importance—a social revolution the like of which has never before been seen. This subject is well worth the earnest consideration of students of economic and social science. The important thing to note here is that it is the present policy of the Department of Agriculture to aid broadly in the education of the farmer along the lines of agricultural science, in the belief that the broadening and deepening of the intellectual life of our rural population are as important, to say the least, as the improvement of their material conditions.

The Office of Experiment Stations promotes the general interests of the American system of agricultural education and research in several ways: (1) It collects and diffuses information regarding the progress of agricultural science the world over through a monthly journal called the *Experiment Station Record* and through numerous technical and popular bulletins; (2) it seeks to formulate the principles on which institutions for agricultural research should be organized and managed, and exerts its influence to secure the practical application of those principles in the management of the state experiment stations; (3) it aids the movement for the technical education of the farmer by encouraging the formulation of a distinct science of agriculture and its reduction to 'pedagogic form'—to meet the requirements of different classes of students. It is now especially promoting the establishment of secondary courses in agriculture and the extension of farmers' institutes.

Besides its general functions, the office has at present certain special duties. It has organized and directly manages agricultural experiment stations in Alaska, Hawaii and Porto Rico, and in cooperation with agricultural colleges, experiment stations, state officials and private organizations in different parts of the country, it is conducting investigations on the food and nutrition of man and on irrigation.

Its nutrition investigations have a broad economic bearing as affecting the food habits of our people and as contributing to the scientific basis of the teaching of home economics in our schools and colleges.

Its irrigation investigations deal with the laws and institutions of communities whose agriculture is wholly or in part dependent on irrigation, and treat of social and economic problems of fundamental importance to such communities.

The office is also beginning studies regarding the use of various kinds of power in agriculture and other subjects in the domain of agricultural engineering, hoping to lay the foundation for a broad treatment of this hitherto neglected branch of agricultural science by the department.

Economic Work of the Division of Entomology: Dr. L. O. Howard, chief of Division.

The work of the Division of Entomology is to investigate insects directly or indirectly injurious to man, and to endeavor to lessen the damage which they bring about. It also includes an investigation of beneficial insects. It has been estimated that insects injure the agriculture of the United States to an extent of more than three hundred millions of dollars annually, and it is further estimated that were it not for the continued investigations and suggestions of economic entomologists, this money loss might any year reach the sum of four hundred and fifty millions to five hundred millions of dollars. The sum expended by the government for investigations of this character, whether under the

state agricultural experiment stations or under the Department of Agriculture, amounts to less than two hundred thousand dollars annually. Public interest in this work and confidence in the recommendations of entomologists is growing. This means that the service is being encouraged by larger appropriations. When the speaker came to Washington twenty-five years ago four thousand dollars was appropriated for this work, which was carried on by two men; now nearly one hundred thousand dollars is appropriated and about twenty-five scientific experts are employed. The work is well systematized and is being carried on under the following heads:

1. Field crop insect investigations, including a southern section which comprises the insects injurious to cotton, tobacco and sugar cane, and a northern section which investigates the species damaging cereals and forage plants.

2. Fruit insect investigations, with a northern section devoted to the deciduous orchard fruits, and a southern section which cares for citrous and other tropical fruits.

3. Small fruit and truck crop insect investigations.

4. Forest and forest-product insect investigations.

5. Insecticide and insecticide machinery investigations, which include a section of field operations and experiments and a section of chemical analyses and tests.

6. Investigations of insects affecting stored products, such as cereal, animal and other food substances, materials and fabrics of all sorts.

7. Investigations of insects in relation to diseases of man and other animals, and as animal parasites. The enormous importance of mosquitoes in relation to malaria and yellow fever, and of flies to typhoid, has drawn very general popular attention toward this phase of the work.

8. Special insect investigations, which include a section for the investigation and introduction of beneficial insects, a section for the study of fungous and other diseases of insects, and a section for emergency and unclassified work.

9. The conduct of an insect laboratory and the care of collections, as well as the care of an experimental garden.

10. Investigations in bee culture.

11. Investigations in silk culture.

The speaker, with some little detail, described some of the operations carried on under these respective heads, and dwelt especially upon the work now being prosecuted in Texas against the Mexican cotton boll weevil, an insect which has caused a money loss to Texas cotton planters, during the past three years, of approximately seventy-five millions of dollars. He showed that this insect may be practically handled by simple variations in the cropping methods in use in the state of Texas, and described certain large-scale demonstrations which have been carried on during the past year upon farms of 150 and 200 acres, respectively.

He also spoke especially of the introduction of a fig-fertilizing insect from Algeria which has rendered possible the cultivation of the Smyrna fig in the United States, and also of the recent introduction of a ladybird beetle from China which feeds upon the San José scale.

Economic Work of the Biological Survey: Dr. C. HART MERRIAM, chief of Division.

The Biological Survey comprises three independent sections: The Biological Survey proper, which studies the geographic distribution of animals and plants and determines the boundaries of the life zones and crop zones; the section of economic ornithology, which studies the food and

food habits of birds with respect to agriculture and horticulture; and the section of game preservation and introduction, which has jurisdiction over matters covered by the provisions of the Lacey Act, and also of the game laws for Alaska.

The Biological Survey proper carries on field explorations in all parts of the country, but does most of its detailed work in the west. It collects data and prepares maps showing the actual distribution of various species of mammals, birds, reptiles, trees and shrubs, and determines the boundaries between the several life zones and areas. By a study of the associations of species distinctive of the several zones in connection with the crops found to thrive best in parts of these zones, it prepares lists of the particular varieties of fruits and other agricultural products adapted to each belt.

The section of economic relations, by studying the food habits of birds in the field, and the stomach contents of birds in the laboratory, determines the economic status of various species of importance from the standpoint of practical agriculture. Birds are studied by species and groups, and an effort is made to ascertain the food of each species during each month in the year and from different parts of the birds' range throughout the United States, so that the results arrived at may be authoritative and final. Among the groups thus far treated are the hawks and owls, crows, blackbirds, orioles, cuckoos, shrikes and sparrows.

The section of game protection and preservation inspects importations of live birds and mammals from foreign countries in order to prevent the introduction of noxious species, such as the mongoose, the large fruit-eating bats, the starling, kohlmeise, and others, and gives permits for the introduction of non-harmful species. It has charge, also, of matters of federal game protection and the interstate commerce in game shipped in violation of state laws. It publishes digests of the state game laws and laws for the protection of birds other than game birds, and other literature bearing on the general subject of game protection.

The Economic Value of the Remaining Public Land: J. D. Whelpley, Washington, D. C.

The land office of the United States has had under its control for disposal under such laws as have prevailed from time to time an area probably amounting to about one billion five hundred million acres of land. About one billion acres of this land have passed from government to private ownership. About five hundred million acres remain subject to the law of congress.

The economic value of the one billion acres which have already been disposed of has been fully demonstrated. The world power of the United States as a nation has become great in direct ratio to the development of the natural resources of the public lands. The tremendous increase in wealth resulting from the rapid settlement of the one billion acres of public land has blinded the people of this country to the serious defects which have existed in the laws governing the disposal of the same.

Not one hundred million acres of the five hundred million remaining are suitable to profitable and comfortable occupation by American citizens under existing economic, physical and social conditions. It is now generally recognized that it is of supreme importance that the government should intelligently conserve the possible economic values of that area of the United States which is still included within the limits of the public domain. Room is needed for more population, more raw material is necessary to maintain our manufacturing industries, and one homesteader

and his family settled happily upon 160 acres of carefully tilled land is worth more to the industrial, commercial, transportation and social interests of the country than the non-resident ownership of a range industry covering many thousand acres.

Every Secretary of the Interior for twenty-five years past has recommended a curtailment of the land privilege. Congress has responded in some degree to this demand, but there is immediate need of radical changes in the laws now upon the statute books. Not another acre of the public lands should be sold for cash or its equivalent. Residence and cultivation should be required before title could be obtained, and this residence and cultivation should be at least five years, so as to insure a permanent and not speculative interest in the holding. The desert-land law and the commutation clause of the homestead act should be repealed, for while there may be isolated cases produced in evidence of the alleged beneficial character of these laws, a vast majority of the land acquired under these filings is for other than the legitimate purpose of settlement, occupation and general development of the country.

In 1902 about twenty million acres were taken from the public domain under the various laws now on the statute books. It is estimated that there will be nearly twenty-five million acres appropriated in 1903. In 1901 there were but sixteen million, and yet at that time that figure was considered enormous and alarming. Those who are building up large land holdings in the west realize that public sentiment is aroused, and they are crowding in every direction to secure title to as much land as possible before congress takes this matter in hand.

It has been argued against the repeal of these laws that the fund created by the national irrigation law from the sale of public lands would be destroyed. In the first place, if these laws were repealed today and existing rights allowed to be perfected there would probably be about twenty million dollars in the reclamation fund. The government would reap an enormous profit on the investment, even if it were necessary to appropriate one hundred million dollars to maintain the fund for reclaiming the arable public lands of the west rather than to allow a continuation of the present system.

The cream of the people's land is being skimmed each year; and with less than a hundred million acres which may be considered as reasonably possible of settlement, it can be but a very short time, at the present rate of segregation, before this has disappeared and the area which congress proposed to improve for the home-builders will have been included within the boundaries of great pastures producing not a thousandth part of their possible annual contributions to the wealth and prosperity of the country.

Outlook of the Timber Supply of the United States: Professor B. E. FERNOW, director, State College of Forestry, Cornell University.

This paper reviewed, upon the basis of the last census and of other statistics, the consumption of wood products in the United States, and the probabilities of meeting the same from the virgin supplies still on hand.

Contrary to expectations, the wood consumption of the leading industrial nations has, in spite of substitutions, constantly increased during the last forty years, and that greatly in excess of the increase in population, as a result of greater industrial activity and higher civilization; the increase in per capita consumption in Great

Britain being by five per cent. annually in the average; for Germany and France, ten per cent., and for the United States the apparent increase indicated by census statistics is above this last figure.

The total wood consumption for the United States is placed at round twenty-five billion cubic feet, of which over seven billion is log-size material, the important part needed for the industries.

After analyzing the relative value and importance of the different parts of this consumption, in which the conifers are shown to furnish three fourths of the log-size material, the question of supply is discussed.

It is shown that Canada, the only country from which such supplies can be imported, can not be relied upon for any length of time.

A probability calculation of the present stand of virgin timber in the United States, ready to supply the demand for lumber, although admittedly on a slender basis, brings out the improbability, if not impossibility, of meeting the increasing demand for another thirty years, under present methods of utilization. Even if the entire forest area of 500 million acres were supposed still fully stocked with the average stand per acre, as reported by the census in the holdings of lumbermen—an absurd proposition—the stock on hand would be exhausted within that period.

The possibilities of securing the requirements from the reproduction in the natural forest are discussed on the basis of European experiences, and with proper reference to the damaging forest fires. It is shown that even under good forestry practice, the present increasing demand could from the present area be supplied only for a limited time. Hence the efforts to secure such forest management and greater economy in the use of timber are not too early, but rather too late, and the dallying with the problem by the legislatures fatal.

Sociological Aspects of the Irrigation Problem: Guy E. Mitchell, editor, *The National Home-Maker.*

The reclamation of arid America through government construction of irrigation works will furnish for years to come an effective outlet for the industrious surplus of our great cities. The irrigation sections of the west present almost ideal rural conditions. The tendency is, where water is used for farming, to subdivide land into small individual holdings, which gives to a community a prosperity and stability not found in larger farming districts, nor in cities. This is not a new idea. But while this is being done, the people of the entire United States will become so educated on irrigation matters and irrigation methods that there will be a gradual spreading eastward of the irrigation idea, which will eventually result in the subdivision of great numbers of large eastern and southern farms and plantations which are now farmed without thought of artificial water supply, into smaller irrigated farms. Never a season goes by even in the best watered districts of the rain belt that there is not some period of plant growth where the judicious application of water would very greatly increase the yield, and in some years double and treble it. It takes only a year of excessive drought among eastern farmers to get them talking about irrigation, but little comes of it, for the reason that they are entirely unfamiliar with irrigation methods and have no idea how to go about the practice of supplementing the natural water supply.

The irrigation then of the one hundred million acres of western plains and valleys, while it will create innumerable small rural homes of five, ten, twenty or thirty acres

each, will serve further to encourage subdivision of larger areas in the east and south and tend to make the small farm and home a general rule throughout the entire country.

Under wise administration, arid America has a glorious future. With her countless small farms and rural homes, communities where people live in the open air, till the soil with their hands and yet enjoy the privileges and advantages of the city, she will prove the sheet anchor of the republic in any time of national peril, while from her will radiate eastward the same idea of the division of the large into small farms and the utilization of the stream and the pond in making certain and increasing an oftentimes unreliable crop.

An Inquiry Into the Composition of Creamery Butter: Major HENRY E. ALVORD, chief of Dairy Division, Department of Agriculture.

The value of butter depends upon the fat it contains, and although there are necessarily other constituents, and they have value, they should not be in excess. This is especially true of the water content. Purchasers do not wish to buy water by the pound at butter prices. The product of creameries, or the factory system, is the leading grade of butter in the markets. Creamery butter has been alleged ordinarily to carry too much water. There has been no reliable basis for such assertions, and it has seemed desirable to ascertain the facts.

During the year 1902, the U. S. Department of Agriculture (Dairy Division) has had opportunity for examining 730 different packages of butter, representing the product of 400 different creameries, located in eighteen states. The butter was made in May, June, August and September. Moisture determinations were made on 802 samples. The range of water content was found to be from 7.20 per cent. to 17.62 per cent., and the general average was 11.78 per cent. There were but three results below 8 per cent. and only eight above 16 per cent. Seven eighths of the 802 samples were between 10 and 14 per cent., and more than half between 11 and 13 per cent.

Making all reasonable allowance for error, it seems safe to state that American creamery butter, during the months named, has an average water content not exceeding twelve (12) per cent.

Education for Farmers: Professor WILLET M. HAYS, Minnesota Agricultural Experiment Station.

The states are gaining charge more and more of education. By unifying the primary and graded schools, the city high schools, and the universities and colleges into an articulated system, education has been greatly promoted. But the current in this system is away from the farm, and a parallel system is suggested in which the student must go against the current to leave the farm. The suggested system includes the consolidated rural school, with free transportation of pupils, serving an area three to five miles square; the agricultural high school, serving ten or more counties; and the agricultural college, serving the entire state. The consolidated rural school supplies superior primary education; could include some studies of rural industries; and a small demonstration farm and garden could be added to the equipment. By extending the course in the consolidated rural school to include the freshman and sophomore high-school studies, the pupils are longer under the parental roof; and the expense of non-resident study in the agricultural high school is reduced to the junior and senior years, which study may be made largely technical. The civic and economic,

as well as the educational, value of such a system is urged:

School Gardens: Miss Louise Klein Miller, director of the Lowthrope School of Horticulture and Landscape Gardening for Women.

Educators are becoming alive to the importance of school gardens as a potent factor in education, and the next five years will see rapid progress in this direction.

The schools of Europe are far in advance of us in this phase of education, and the agricultural and horticultural progress is largely due to the efficiency of the school gardens. In Austria-Hungary alone there are 18,000 school gardens. In France, the teachers are required by law to be able to instruct their pupils in the elements of agriculture and horticulture, and normal schools have been established for the purpose of giving teachers such training. No plans for school buildings to which the state contributes are approved unless accompanied by plans for a school garden. The study of horticulture is compulsory in Belgium. In Germany and England, school gardens are encouraged, but not regulated by law. Some excellent work has been done in this country, but in many instances the educative features have been made subservient to the raising of vegetables.

The theory and practice of gardening satisfies certain dominant interests in a child's physical, mental and moral evolution; affords an opportunity to expend normally and naturally often misdirected energy; develops an appreciation of the proper values of things; quickens a knowledge of the close interrelations in nature; gives fundamental principles of great economic significance; suggests some of the great problems in the struggle for existence; teaches the dignity of labor and personal responsibility.

The day is not far distant when a supervisor of school gardens will be as important an officer in a school system as a supervisor of music or drawing. Children are not satisfied with evasive answers. They are alert, inquisitive and intelligent, and a teacher who wishes to gain their confidence and keep their respect must be able to respond to most of the demands made upon her, and have her knowledge at her tongue's end and finger tips. This is an open field for women, and in this capacity an earnest, capable and enthusiastic teacher can render valuable service to the public good.

A difficult problem for the economist and sociologist to solve is the herding together of a large population in a crowded city. Strenuous efforts are being made to turn the tide countryward, and induce persons to seek homes where life will be freer and more wholesome. If the elements of agriculture and horticulture were taught in country, town and, so far as possible, in city schools, in an intelligent, scientific and attractive manner, life in the country would be the joy that the opportunity affords.

Frank H. Hitchcock,
Secretary.

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*THE UPPER TEMPERATURE LIMITS OF LIFE.**

The upper temperature limits of continued and active life are possible of observation most satisfactorily in the case of the organisms inhabiting hot springs. Such springs are widely distributed in both hemispheres and vary in temperature from tepid to boiling. In all these springs, except in the very hottest waters and in those in which there is something in the chemical composition which prevents, organisms have been found. Various indi-

* Abstract of an address before the California Chapter of the Sigma Xi, Berkeley, April 28, 1903.

vidual references have been made to the organisms living at higher temperatures in such springs, such as are tabulated by Davenport in his 'Experimental Morphology' (Vol. I., pp. 249–267), under the heading of 'Acclimatization to Heat.' As may be seen from the references there given, and more particularly from Davenport's notes on the different records, as well as from an examination of the records themselves, there is a very decided lack of good strong evidence as to exact temperatures and the kinds of organisms occurring at the temperatures given or hinted at. The records are largely of isolated observations, generally made incidentally and without, in any case, being a portion of any extensive work to determine temperature limits. As far as the literature goes, there seems to have been nothing systematic attempted along these lines.

It has been my own good fortune to study with considerable care and thoroughness the thermal organisms of several distinct regions. The first observations were made at the Arrowhead and Waterman Hot Springs near San Bernardino, California, being introduced to them through the kindness of Mr. S. B. Parish of that city. The visits made to these springs were three in number, in as many different years. The organisms of the hot waters of the so-called geysers in Sonoma County, California, as well as those of several minor hot springs near Calistoga, in Napa County of the same state, were collected and the temperatures carefully noted in June, 1900. In August, 1898, ten days were spent in the Yellowstone National Park, under the auspices of the United States Geological Survey, examining the life in the hot waters of the Mammoth Hot Springs, the Norris, Lower, Middle and Upper Geyser Basins, the Lakeshore Hot Springs, and of other lesser collections of springs. In all, several hundreds of gatherings have been made, the specimens carefully preserved and studied, and the results are awaiting publication. Among other things, especial care was taken to determine accurately and record the exact temperature at which each specimen was growing, so that the data of this character might be complete for the whole series. Not only were the highest temperatures at which living organisms were found, taken, but the temperatures of all organisms inhabiting strictly thermal waters. The results of all my own observations agree perfectly and present a series of facts somewhat at variance, at least in certain essential details, with the results of other observations as tabulated by Davenport. Many, or even the large majority, of the discrepancies disappear, or may be plausibly explained, however, when one considers how erroneous certain temperature observations may be, unless taken with certain precautions.

In my own work it was found very soon that, unless very considerable care was exercised, the temperatures were not those at which the organism was living. It was found, for instance, that it was extremely misleading to take the temperature of a spring and then credit the temperature of any organism existing at any distance from that point as being the same. The central portion of a spring with shallow margins may be of a considerably higher temperature than the margins. In the case of streams, the temperature of two points only a few centimeters distant from one another may differ 10°–15° C. on account of currents imperceptible except to the thermometer. Especially is this likely to be the case in springs or overflows into which colder currents come from side streams, whether these be of thermal or cold waters. The temperatures of masses

of organisms partly or wholly emergent from the waters are difficult to ascertain with certainty, but in the majority of such cases which have come under my own observation, the only living portions of such masses were comparatively cool. The temperatures which seem sufficiently certain to place implicit confidence in were taken with the following precautions: (1) temperatures only of submerged tufts were taken; (2) the bulb of the thermometer was placed within, or just at, the sample which was removed and preserved for microscopical study; and (3) in a very considerable number of cases, particularly of the highest temperatures noted, samples and temperatures were taken at the same spot on different days, or times of the year.

The results of all these observations, taken with the precautions indicated above, give certain general results for the strictly thermal waters—*i. e.*, for waters over 43°–45° C. The temperature results may be indicated under a number of different heads:

1. No animals were found in strictly thermal waters, although careful search was always made for them.

2. No living diatoms were found in strictly thermal waters. At times, a few empty valves were found, but these may easily have been blown in, since the localities were in the neighborhood of extensive areas of diatomaceous earth.

3. All the organisms found in my own collecting in strictly thermal waters belong to the groups of plants designated as Schizophyta, being either Schizophyceæ (Cyanophyceæ) or Schizomycetes (Bacteria). These two groups possess a simple morphology and peculiar cell-structure.

4. The chlorophyllose Schizophyceæ (or Cyanophyceæ) commonly continue up to 65°–68° C., and in some cases, but scantily, up to 75°–77° C.

5. The chlorophylless Schizomycetes (or bacterial forms) endure the highest temperatures observed for living organisms, being abundant at 70°–71° C. and being found in some considerable quantity at 82° C. and at 89° C.

6. The temperature of 89° C. is the highest at which I have been able to find any organisms living. This temperature was taken at several different times and on two separate days. The organism belongs to the filamentous Schizomycetes. Search was made most carefully at the 'geysers' of Sonoma County, California, for green organisms at 93° C., as recorded by Brewer, but no life was observed at any temperature above 68° C.

7. Living organisms were found at higher temperatures in siliceous waters than in calcareous waters.

8. The limits of life in the siliceous waters, as determined by my own observations, are between 75° C. and 77° C. for chlorophyllose, and 89° C. for chlorophylless Schizophyta.

9. The limits of life in the calcareous waters, as determined by my own observations, are between 60° C. and 63° C. for chlorophyllose Schizophyta and between 70° C. and 71° C. for chlorophylless Schizophyta.

10. No organisms were found in springs reputed to have a decided acid reaction. This needs more study, but where a strong acid (sulphuric) character is given for a spring, the waters are free even from Schizophyta.

A careful study of the species of thermal Schizophyta shows several details of interest. They are either filamentous or unicellular, but in each case the filaments or cells are enclosed within a jelly, usually abundant. Within the strictly thermal

limits, only one member of the higher and heterocysted Cyanophyceæ has been noted, viz., *Hapalosiphon laminosus*. This species does not reach the upper temperature limits, even for the chlorophyllose forms. The majority of the chlorophyllose forms are either species of *Phormidium* or unicellular forms peculiar, as far as known at present, to the thermal waters. The chlorophylless forms, as far as detected, are filamentous, very slender, and belong to the group known as the sulphur bacteria. All of these forms are very closely related, even the so-called sulphur bacteria being little else than colorless species of *Phormidium*. A matter to be emphasized is this—that all of the strictly thermal organisms are low forms, not even representing the higher differentiation in the group to which they belong.

The question is always raised, in the case of the thermal organisms, as to the nature of the protoplasmic contents of the cells. What is it that enables the protoplasm of the thermal organisms to withstand a temperature which coagulates, and consequently kills, the protoplasm of the majority of organisms. We find that when a proteid, like egg albumen, is free from water, it does not coagulate at the very highest temperatures which leave it unburned, and that the less the content of water, the higher the temperature of coagulation. The cell structure in the Schizophyta is peculiar, being quite different from that of other groups of organisms. While the details are not satisfactorily settled, there seems to be a certainty that there is less differentiation than in other groups. Whether we believe that the protoplast is all nucleus or whether we believe that it is all cytoplasm, it remains clear that it is different from the protoplast of other groups of organisms and affords us room for surmise. There is nothing, so far as my own study of the Cyanophyceæ cell is concerned, to indicate that the protoplasm contains so little water as to render it incoagulable by the higher temperatures which it endures. It seems rather that there may be some important difference in the essential proteids of the mixture, or in the nature of the constitution of the substance, if it be regarded as simple, which renders it less coagulable, a difference similar to that existing between a substance of the group of the vitellins and one of the group of the globulins.

WILLIAM ALBERT SETCHELL.

SCIENTIFIC BOOKS.

THE SUGAR INDUSTRY.

Anleitung zur Untersuchung der für die Zuckerindustrie in Betracht kommenden Rohmaterialien, Produkte, Nebenprodukte und Hilfssubstanzen. Sechste umgearbeitete und vermehrte Auflage. Von R. FRÜHLING. Braunschweig, Friedrich Vieweg und Sohn. 1903. Pp. xxi + 505. Marks 12.00.

The rapid advances made in sugar chemistry within the past few years have necessitated a thorough revision of and the introduction of a considerable amount of new matter in this, the sixth, edition of Frühling's 'Anleitung.'

Examination of the book shows that the author has spared no pains to do justice to his self-imposed task.

Adoption of the regulations of the International Commission for Uniform Methods of Sugar Analysis, Paris, July 24, 1900, has of course resulted in the introduction of fundamental changes. The metric cubic centimeter has replaced the Mohr cubic centimeter; the normal sugar weight is now 26,000 grams instead of 26,048 grams; 20° Centigrade has been accepted as the standard temperature for the preparation and the polarization of sugar solutions. Space is given to the extensive table showing the relation between the specific gravity of sucrose solutions at 20° C. and the sucrose percentage of such

solutions, which table has been prepared by the Imperial *Normaleichungskommission.* Attention has also been paid to the determination of the alkalinity of first products, to the determination of sucrose in the presence of invert-sugar, raffinose, etc.

About one half of the book is given over to sugar-analysis, or rather, to be more precise, to the analysis of sugar and sugar-containing compounds. The rest of the work treats of the analysis of bone-black, water, limestone, gas-analysis, fuels, fertilizers and so on, and in most of these sections considerable changes and improvements are also to be noted.

A recalculation of all numerical data and problems was made imperative by adoption of 16 as the atomic weight of oxygen.

Paper and print are excellent, and the numerous illustrations a feature of value.

F. G. Wiechmann.

SOCIETIES AND ACADEMIES.

THE AMERICAN PHYSICAL SOCIETY.

The spring meeting of the Physical Society was held at Columbia University, New York City, on Saturday, April 25. An unusually large program of fifteen papers was presented, and the attendance was above the average.

The first article was by H. T. Barnes and E. G. Coker, and dealt with the 'Flow of Water through Pipes in Stream Line Motion with Special Reference to the Critical Velocity.' By taking every precaution to have absolutely quiet water in the tank which supplied the pipe studied, it was found possible to increase the critical velocity much beyond the limit found by previous observers. The presence of little disturbances in the water entering the pipe seems to have a strong tendency to break up stream line flow into an irregular eddy flow. For small pipes the authors found that two critical velocities might be observed. As the velocity was increased from a low value a speed was reached at which stream line flow ceased and eddies formed. If the velocity was increased still more, another critical stage was reached, beyond which the flow again occurred in stream lines.

Messrs. H. T. Barnes and D. McIntosh described a form of platinum thermometer especially designed for work with the continuous flow calorimeter and avoiding many of the difficulties met with in previous forms.

In a paper on 'Architectural Acoustics' G. W. Stewart described a series of experiments made in the auditorium of Sibley College at Cornell University. The reverberation in this hall when first completed was so bad that a speaker could hardly be understood at all. It seemed to offer a good opportunity to test the methods and conclusions developed by Sabine in his work on architectural acoustics. Mr. Stewart found a complete agreement between the results obtained by experiment and those computed upon the basis of Sabine's theory.

A paper on the 'Spectral Energy Curve of a Black Body at Room Temperatures' was also presented by Mr. Stewart. In order to obtain radiation from a body at room temperature the vane of a radiometer was used as a radiating surface, while in front of the slit of the mirror spectrometer used was placed a body at the temperature of liquid air. Under these circumstances, since the radiation from so cold a body is practically nil, the cooling of the radiometer would be due to its own radiation, and the deflections observed in the different parts of the spectrum would measure the radiation for particular wave-lengths. The curve showing the distribution of energy in the spectrum had the same general form as that observed at higher temperatures. The maximum occurred at $9.2\,\mu$, the position of the maximum differing from that computed by Wien's formula by about $0.6\,\mu$. The energy curve was compared with that computed from Planck's theory, and variations of ten per cent. were noticed, although the curves were alike in general form. In view of the fact that the maximum deflection obtained was not quite 4 mm., such differences were not surprising.

The results of determinations of the specific heats of certain organic solids were presented by W. F. Magie. Fourteen substances were examined, the Pfaundler calorimeter being employed. The results were compared with

the theory advanced by Staigmüller, showing a reasonably close agreement. The heats of solution in water were also determined.

An article by E. H. Hall 'On C_v for Liquids and the a of Van der Waals' called attention to a disagreement between observation and certain conclusions based upon Van der Waal's equation.

Mr. A. W. Smith described the methods used in a careful redetermination of the Heat of Fusion of Ice. An electrical method was employed, every precaution being taken to obtain results in absolute units. A calculation based upon a preliminary determination gives 334.25 joules for the heat of fusion of ice prepared from pure distilled water.

Mr. J. S. Shearer reported the results of a determination of the 'Heat of Vaporization of Nitrogen,' the method being that previously used by him in determining the heat of vaporization of oxygen. The value found was 49.8 calories per gram. Since the latent heat of oxygen is much greater than this, it becomes a matter of interest to determine the heat of vaporization of air as a function of its composition. This determination had been carried out by J. S. Shearer and F. R. Strayer, who reported that the heat required to vaporize air is the same as would be required to vaporize the constituents separately.

It has long been known that ordinary slow evaporation is not accompanied by electrification. When a mass of water is suddenly shattered, however, as in jets, marked electrical effects are produced, but these persist only for a short time. The question then arises whether electrical effects may not be present in ordinary cases of evaporation, vanishing so quickly as to be undetected. Experiments to test this point, by investigating cases of *sudden* evaporation or condensation, were described in a paper by Carl Barus. No electrical effects could be detected.

Mr. Barus also presented a paper showing that condensation nuclei are produced by the mixture of ordinary coal gas and air. The nuclei are not ionized. They are probably due to chemical action resulting from the presence of sulphur in the gas.

'A Preliminary Note on the Selective Absorption of Organic Compounds in the Infrared' was presented by W. W. Coblentz. Thirty-eight substances had thus far been studied, observations extending to a wavelength of 15μ. The results were of especial interest in the case of related compounds, for example, the substitution derivatives of benzene. Certain radicals, such as CH and CH_3, were found to produce well-defined bands in the absorption spectrum of any substance in which they appeared. In some instances series of bands were found in which the wavelengths were simple multiples of one another (*e. g.*, CH_3 bands were found at 3.5μ, 7.0μ, 10.5μ). As its title indicated, the report is preliminary. Mr. Coblentz is to continue the work with the aid of a grant from the Carnegie Institution.

The remaining papers on the program were: 'An Attempt to Construct an Electrostatic Transformer,' J. E. Ives; 'Note on the Bending of Rock Salt,' W. W. Coblentz; 'A Modification of the Quadrant Electrometer without Liquid Contacts,' C. Barus.

At the meeting of the council fifty-five new members were elected. This number of elections exceeds that of any previous meeting, and doubtless indicates the appreciation by the physicists of the country of the recent arrangement made by the society with *Science Abstracts* and the *Physical Review*. The proceedings of the society are now published in the *Physical Review*, which is sent to all members. The Physical Society also cooperates with the Institution of Electrical Engineers and the Physical Society of London in the support of *Science Abstracts*. Membership in the Physical Society thus carries with it a subscription to both the *Review* and the pure science part of *Science Abstracts*, at a total cost of only a little more than half the regular price of these two journals.

Under these circumstances it is evident that the question of discrimination in the election of new members becomes an important one. The question was discussed at some length, and the sentiment in favor of a distinctly conservative policy was unmistakable. The Physical Society is not to be an honorary society, such, for example, as the National

Academy. But effort is to be made to keep it a *working* society, and not merely an association of men having some general interest in physics. It is expected that new members will in general be chosen only from the active workers in physics—from such as have either already contributed to the advancement of the science or have shown especial promise of becoming investigators later. That exceptions to this policy may occasionally be made is of course probable, but it was felt that such exceptions should be rare.

ERNEST MERRITT,
Secretary.

NORTH CAROLINA SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE spring meeting of the section was held in the chemical lecture room of the University of North Carolina, Chapel Hill, on May 8, 1903, at 8:15 P.M., with Presiding Officer Charles E. Brewer in the chair. After the transaction of some miscellaneous business, the following papers were presented and discussed:

A Simple Hydrogen Sulphide Apparatus: CHAS. E. BREWER.

This apparatus is an adaptation of well-known principles. Its peculiar interest lies in the fact that it may be used on the laboratory desk. The parts are a bottle (250 c.c.) with a two-hole rubber stopper to fit, a separatory funnel (100 c.c.) passing through one of these holes to the bottom of the bottle to serve as a reservoir for the acid, an Erlenmeyer flask (any size desired) with a one-hole rubber stopper to fit, glass and rubber tubing to connect bottle and flask, with as many wash bottles between as may be desired. The bottom of the bottle is covered with shot to a depth of one inch, so as to keep the acid off the sulphide while the gas is not needed. The delivery tube passes through the stopper to the bottom of the flask which contains the solution to be treated. The stopper is inserted loosely until the air in the flask is driven out, then tightly to prevent escape of gas, which comes over as fast as it can be absorbed. It hastens saturation to shake the flask from time to time.

The Assimilation of Nitrogen by Bacteria: G. S. FRAPS.

This refers to bacteria which assimilated nitrogen without symbiosis. The effect of the nature of the medium, the time, the temperature and the soil used for inoculation of the medium were studied. Addition of magnesium sulphate to a medium containing glucose, potassium phosphate, ferric chloride, sodium chloride and calcium carbonate increased the amount of nitrogen assimilated.

Nitrification of Different Fertilizers: W. A. WITHERS and G. S. FRAPS.

The nitrification of different fertilizing materials was compared in four soils. There was some variation. Placing the amount of nitrogen nitrified in cotton seed meal at 100, the amount of ammonium sulphate nitrified varied from 13 to 127; dried blood, 70 to 120; fish, 85 to 190; bones, 22 to 43, while less nitrification took place when barnyard manure was present than when it was absent. Very much larger amounts of manure were used than are used in farm practice, and with smaller amounts different results would perhaps be obtained.

Nitrifying Powers of Typical North Carolina Soils: W. A. WITHERS and G. S. FRAPS.

The nitrifying powers of fifteen typical soils, collected and classified by the Bureau of Soils, and the North Carolina Department of Agriculture, under the same conditions as regards temperature, water content, number and kind of germs, and time, varied from 11 to 106, compared with a standard soil placed at 100. The soils with the lowest nitrifying powers are sands, with low water capacity, low humus, low absorptive power for ammonia and low acidity, though a soil low in any or all of these does not necessarily have a low nitrifying power. Acidity of the soil did not prevent nitrification.

Report—Progress of the Dyeing Industry: G. S. FRAPS.

A discussion of the most important lines of advancement, particularly as regards the introduction of sulphur colors, the production of mercerized cotton and artificial silk, and the manufacture of synthetical indigo.

Derivatives of Trichlorethylidene di-p-nitrophenamine: A. S. WHEELER and M. R. GLENN.

This body, on treatment with alcoholic potash, gives a monohydroxy-derivative by replacement of one chlorine; with sodium methylate, a monomethoxy-compound; with bromine, a dibrom-derivative with bromine in the rings; with zinc dust, a compound containing no chlorine.

Determination of Glycerine: A. S. WHEELER and W. R. WELLER.

Chaumeil's method in which iodic acid is used was found to give high results.

Mercurous Sulphide: CHAS. BASKERVILLE.

This body was formed by the prolonged action—through five years—of concentrated sulphuric acid (99.65 per cent.) upon pure mercury.

Recent Work on the Rare Earths in the Chemical Laboratory of the University of North Carolina: CHAS. BASKERVILLE.

An abridgment of his recent lecture before the New York Section with two additions; first, a new method for purifying neodidymium (with Stevenson), and second, an elaboration of that portion touching radioactive bodies and fluorescence. The paper was fully illustrated with specimens and a few experiments.

Note on the Thermodynamical Calculation of the Latent Heat: J. E. MILLS.

Attention was called to the fact that when the constants for Biot's formula were known, differentiation of this equation would give $\delta p/\delta t$. Substitution in the ordinary thermodynamical equation for calculating the latent heat could then be directly effected, with a great saving in the calculations involved.

Molecular Attraction: J. E. MILLS.

If at any temperature the internal latent heat of vaporization be divided by the difference of the cube roots of the densities of liquid and vapor, the result should equal a constant, according to a published theory of molecular attraction (*Jour. Phys. Chem.*, April, 1902). It was shown that the latent heats for ether, benzene and carbon tetrachloride gave a good agreement with the theory to within a few degrees of the critical temperature.

Some New or more or less Novel Forms of Laboratory Apparatus: J. M. PICKEL.

(*a*) An unusual form of siphon.

(*b*) A modified form of a previously described filter-washer.

(*c*) An automatic measurer and dispenser of the acid used in Kjeldahl nitrogen determinations.

(*d*) Same for the alkalies.

(*e*) A stand for Kjeldahl digestion flasks.

(*f*) A file for samples contained in bottles.

(*g*) A desiccator for equalizing inside and outside air pressure.

(*h*) An appliance for utilizing the incandescent electric light as source of heat in fat extractions with ether.

(*i*) An asbestos furnace for gold assays.

(*j*) An economical but efficient blast-lamp.

(*k*) Spiral support for round-bottom flasks.

An Efficient Asbestos or Graphite Muffle: J. M. PICKEL and C. B. WILLIAMS.

This muffle has been used principally in the determination of potash in fertilizers. It is very efficient and has given satisfaction in other respects. A description of it will soon appear.

After the completion of the program Dr. Charles Baskerville tendered the members of the section and their friends an informal 'smoker' at his residence.

C. B. WILLIAMS,
Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 144th meeting of the society, held in assembly hall of the Cosmos Club, Wednesday evening, May 6, 1903, the following program was presented:

Professor Lester F. Ward: 'Correlation of the Potomac Formation in Maryland and Virginia.'

In this paper Professor Ward outlined the present status of the Potomac formation, as determined from numerous rich collections made in recent years, chiefly by the Maryland workers, and studied and reported upon by Professor Fontaine. The position and extent of the Potomac belt within Maryland and

Virginia and the principal localities represented in the collections were shown by maps. The entire review, with Professor Fontaine's reports, and numerous plates, will be published shortly as a professional paper of the U. S. Geological Survey.

Mr. M. R. Campbell: 'Pocono Rocks in the Allegheny Valley.'

Recently Mr. David White and Mr. Campbell obtained fossils from the Allegheny Valley which show (1) that Pocono rocks having a thickness of at least 130 feet are present in Armstrong County, Pa.; (2) that the Pottsville is 140 feet in thickness and consists of the Homewood and Connoquenessing sandstones separated by the Mercer coal group; and (3) that the well-marked Pocono and Pottsville are separated by a mass of sandstone and sandy shale having a thickness of about 80 feet and apparently barren of fossils. Although these beds can not be classified definitely, there are some reasons for referring them to the Pocono. If this reference is correct the Mauch Chunk shales and Sharon conglomerate are absent and the Connoquenessing sandstones rest directly on rocks of Pocono age.

Mr. David White: 'Age of the Mercer Group.'

Under this title Mr. White communicated certain conclusions and correlations resulting from the study of the fossil plants of the group. He described the pteridophytes of the Mercer flora as a mixture of distinctly upper Pottsville elements with the earliest, and often slightly archaic, representatives of the common species of the Allegheny. Considerable change is noted between the plants in shales resting on the top of the Connoquenessing at certain localities and those immediately underlying the Homewood sandstone at others, the duration of Mercer time, as indicated by the floras, being greatly disproportioned to the relatively small thickness of the group in Pennsylvania and Ohio. Such a comparative duration is, however, in part suggested by the composition of the group, which embraces coals, limestones, iron ores and fire-clays in the northern region. The associated fossil plants indicate that the refractory or 'flint' clays worked at many points in Somerset, Cambria, Centre, Clearfield and Jefferson counties, as well as the famous Mount Savage clays in western Maryland, belong to the Mercer group, which is shown to be the stage of a belt of refractory fire-clays extending irregularly from the Potomac basin, in northern West Virgina, northward around the border of the main bituminous field through McKean County and as far as St. Charles on Red Bank Creek in northern Armstrong County.

The Mercer group is correlated by the author of the paper with the lower stage of the Westphalian (Sudetic) or the Lower Coal Measures of Europe. The more complete knowledge of its flora throws much light on the age of the Kanawha formation in the southern Virginia regions, additional collections from which have recently been examined. In a discussion of the age of the Kanawha in 1899, the speaker had shown that the greater portion, embracing not less than 600 feet, of the formation, antedated the Allegheny formation, although the northern equivalents of the formation were not definitely known. It now appears that its partial equivalence with the Mercer, then conservatively proposed, is conclusively shown by the plants, and that a great portion of the Kanawha formation is to be regarded as the southern extension of the Mercer group. The further study of the floras indicates not merely that the middle of the formation may be of Mercer age, but that beds up to within 125 feet of the 'Black Flint' are clearly referable to the latter group, while the basal Allegheny time boundary is probably very much nearer the level of the Black Flint.

During the evening of May 13 a special meeting was held in continuation of the 140th regular meeting, which was devoted to a discussion of the 'Quantitative Classification of Igneous Rocks.' No formal papers were presented, but the practical workings of the new classification were commented upon by several petrographers who had tested it, and observations, critical and commendatory, from foreign workers were read and discussed.

W. C. Mendenhall,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 569th regular meeting was held May 9, 1903. The first paper was by Dr. H. Carrington Bolton, on 'The Genesis of Hygrometers and Anemometers.'

The earliest recorded instruments for measuring the moisture in the atmosphere were those of Nicolas de Cusa, about 1450; they were bits of wool and of sponge fastened to one arm of a balance. Leonardo da Vinci invented a more perfect hygrometer, consisting of a metallic ring with a graduated scale which bore at its center a movable rod, to the ends of which were fastened small spheres of metal, one covered with wax and one with cotton wool. Leonardo thought the wax repelled moisture and the cotton absorbed it.

Sanctorius in his 'Medicina statica' (Venice, 1614) mentions three hygroscopic substances, the 'dregs of alum,' thin boards and strings of a lute.

The Italian physicists of the Accademia de Cimento employed a conical vessel filled with ice for condensing the moisture of the air. The ingenious Robert Hooke describes in his 'Micrographia' (1664) a hygrometer, the essential feature being the awn of wild oats.

The weather-mannikin, still common in Germany, was invented in 1685 by Wm. Molineux. In the eighteenth century a very great variety of hygroscopic bodies were employed, from wood through guts of animals to marine algæ and deliquescent salts, but De Saussure's hair hygrometer was found to excel.

John Dalton in 1801 proposed noting the dew point, and Leslie's psychrometer was invented about the same date. Daniell's condensing hygrometer dates from 1820.

The earliest anemometers were those invented about 1578 by Egnatio Danté, a Dominican monk. It is similar to that of Wild's tablet-anemometer reinvented in 1860. The speaker described briefly a large number of instruments for measuring the velocity of the wind down to Robinson's cup anemometer now in use, first brought out in 1850.

Dr. Bolton called attention to the fact that every one of the fundamental instruments now used in meteorological observations is of Italian parentage:

1450.......Hygrometer, Nicolas de Cusa.
1578.......Anemometer, Egnatio Danté.
1595.......Thermometer, Galileo.
1639.......Raingauge, Cartelli.
1643.......Barometer, Torvicelli.

Mr. E. E. Hayden, of the Naval Observatory, then described, with aid of lantern observations, the 'Naval Chronometer and Time Service.' The Navy possesses about 800 chronometers, and for the rating of these elaborate provision is made at Washington; further facilities are provided at Mare Island Navy Yard, Cal., and at Cavite. The tests used were described, diagrams were exhibited to show the actual behavior of instruments under service conditions, and the details of the daily telegraphic time service were explained.

The last paper of the evening, by Mr. J. F. Hayford, dealt with the unusual features of the plans of a primary triangulation party of the Coast and Geodetic Survey on the 98th meridian triangulation in 1902. The triangulation was done at considerably more than double the usual rate for such work in the past, and at half the usual cost per station occupied under similar conditions. The work of a single season furnishes an arc of the meridian 6° long, twice as long as the famous Peruvian arc. The accuracy of the work is fully up to the best standards of the past. The observations were made upon heliotropes in the day hours and upon acetylene lights at night. The light keepers were given their orders by heliograph signals. Many of the observations were taken under apparently bad conditions upon very faint images, or images which were very large and fluctuating wildly. The observing towers, 42 feet high upon an average at each station, were erected by a separate building party of seven men, at an average rate of ten per month, the towers being scattered throughout the whole extent of the arc 446 miles long. No screens were found to be necessary to shelter the inner tower from the sun and wind, although such screens have been regularly used in the past.

The 570th meeting was held May 23, 1903. The evening was devoted to memorial addresses on deceased members as follows: By Dr. A. F. A. King, on Dr. S. C. Busey, lecturer, sanitarian and author; by Mr. B. R. Green, on Mr. Edward Clark, for many years architect of the Capitol; by Professor F. H. Bigelow, on Professor William Harkness, late of the Naval Observatory; by Mr. H. L. Marindin, on Professor Henry Mitchell, hydraulic engineer, latterly of the Massachusetts Institute of Technology; by Dr. Swan M. Burnett, on Mr. Charles Nordoff, journalist and author; by Mr. G. W. Littlehales, on Admiral W. T. Sampson, U.S.N.

Notices of Major J. W. Powell and Mr. J. W. Osborne that had been expected were unavoidably postponed. Charles K. Wead,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 346th regular meeting was held on April 28.

Professor W. H. Holmes gave an account of his explorations in a hematite mine in Franklin County, Missouri, where there are ancient workings consisting of pits and drifts honeycombing the whole mass of ore. Numerous stone hammers, flint and chips were found about the pits, and it is evident that this locality was a favorite one among the Indians for procuring paint which occurs in pockets in the iron ore.

A communication from Mrs. Catherine Foote Coe, giving her impressions of travel in Japan, was heard with great interest, and a vote of thanks was extended to her.

Dr. W J McGee announced that the International Archeological Commission for the study and preservation of antiquities, which originated at the Pan-American conference held in Mexico in 1901, has made progress toward organization, and that on the third Monday in December next the representatives of the American republics will meet with adequate powers to complete the organization.

Mr. Ainsworth R. Spofford read a paper entitled 'The Folk-Lore of Popular Sayings.' Mr. Spofford, in calling attention to the great collections of sayings and proverbs in different languages, spoke of the wealth of such sayings in English and Irish. These, he said, possess a distinct ethical value in that they are almost invariably optimistic. The best sayings are of Latin, Greek or Oriental origin from the ages past. Sayings relating to the inanimate world, the animate world, professions in life and color were given, also rhymed sayings, sayings of noted men, maxims of unknown origin, weather proverbs and sayings referring to the days of the week. In the discussion of the paper Professor McGee remarked that proverbs prevail in lower culture and are wonderfully paralleled among different tribes, and said that we may almost predicate the stage of development of a people by their use of proverbs. In answer to a question Mr. Spofford said that no one can trace the origin of proverbs. The secretary pointed out the debt of language and literature to these pithy sayings, which are in reality word sentences. Mr. Pierce said that in many cases proverbs show their locality of origin, and Mrs. Tulloch gave examples. The president, Miss Fletcher, said that among Indians ethical proverbs are used in teaching, as, 'Stolen food does not satisfy hunger,' an expression of the Omaha.

'Some Exploded Theories concerning Southwestern Archeology' was the title of a paper by Mr. U. Francis Duff. These myths are the exaggerated estimates of early population, a distinct race of cliff dwellers, dwarf tribes, the destruction of tribes by cataclysms or pestilence, the destruction of villages by lava, the Gran Quivera myth, and the finding of gold in the southwestern ruins. Professor McGee, in discussing the paper, said that in the valley region the extensive irrigation works show that the population was very large, as it would not be necessary to take water far out in the valley to higher levels if the land were not occupied in the near valley. In answer to a question by Mr. McGuire as to the Spanish origin of the ditches, Professor McGee said that the irrigation works show no traces of European culture. Other points were taken up and discussed by members.

Walter Hough,
Secretary.

SCIENTIFIC JOURNALS AND ARTICLES.

THE May number of the *Botanical Gazette* contains a paper by Dr. A. A. Lawson, of Leland Stanford University, on 'The Relationship of the Nuclear Membrane to the Protoplast,' in which he holds that the typical nucleus of the higher plants is a water cavity, structurally similar to the vacuole, the chromatin being the only permanent constituent, while the nuclear membrane originates by the cytoplasm coming in contact with the karyolymph, just as the tonoplast is formed by the cytoplasm coming in contact with the cell sap. Dr. B. M. Davis concludes his paper on 'Oogenesis in *Saprolegnia*,' with an extended theoretical discussion of the homologies, origin and evolution of the coenogamete, the occurrence of coenogametes among the Ascomycetes, the phylogeny of Phycomycetes and Ascomycetes, and the nucleus of Phycomycetes in ontogeny. An ecological paper by Mr. J. Y. Bergen, now residing in Naples, discusses the thickets of under shrubs known locally as *macchie* of the Neapolitan coast regions. Dr. F. L. Stevens, of the Agricultural College of North Carolina, describes the occurrence of 'Nutations in *Bidens* and Other Genera,' quite similar to the well known nutations of the sunflower. Fernow's 'Economics of Forestry,' Boulger's 'Woods'; 'Postelsia' and other current works are reviewed.

THE July number of the *American Journal of Mathematics* contains the following articles:

'Isothermal-Conjugate Systems of Lines on Surfaces.' By L. P. Eisenhart.

'Some Differential Equations connected with Hypersurfaces.' By G. O. James.

'On the Forms of Sextic Scrolls of Genus Greater than One.' By Virgil Snyder.

'Geometry on the Cuspidal Cubic Cone.' By Frederick C. Ferry.

DISCUSSION AND CORRESPONDENCE.

THE PROPOSED BIOLOGICAL STATION AT THE TORTUGAS.

TO THE EDITOR OF SCIENCE: In the marine biological stations (which carry on, it must be remembered, only a portion of all biological work) two tendencies, opposite at first sight, but really directed toward the same high aims, are discernible. The one tendency is to investigate the phenomena of structure, development and function in the individual; the other is to consider individuals in masses as species, as form-units bearing the imprint of environment, and adapted thereto, and as constituents of faunas. For students of the first sort of marine zoology what is required is one large central laboratory, with an extensive library and the requisite cytological and physiological apparatus, where students of anatomy, embryology and physiology may work together and give mutual aid and stimulus. The needs of the workers on the other side of marine zoology call for several laboratories, widely separated, in diverse environments. These will assist the first sort of laboratory by furnishing particular kinds of material found only in the locality. But their chief work will be to study the fauna, determining the laws of geographic distribution of organisms, the variation of species in different environments and the interaction of organisms. Such laboratories will, of course, be exclusively for research, and should be equipped with everything requisite for the collection, the study alive and the rearing of organisms.

While the Woods Holl Laboratory provides a home for the first-mentioned investigations, and will, with increased resources, be able to provide still better for them in the future, the needs of the second sort of biology are still imperfectly met. On the middle Atlantic coast there is a series of laboratories that are of value for this work, as at Harpswell, Woods Holl, Cold Spring Harbor, Beaufort and Bermuda. And on the Pacific coast we have the Hopkins Laboratory and that of the University of California. The pressing needs are now for one or more stations on the Gulf of Mexico and the Caribbean Sea—those vast mediterranean seas our failure to investigate whose fauna remains to-day one of the great reproaches to American zoology. Every zoologist who is more than half a zoologist will be glad to see this reproach removed.

In Europe individual enterprise or university initiative backed by government support has established a magnificent chain of biological research stations reaching from Tromsö, Norway, and even the White Sea, along the North Atlantic, the Baltic and North seas, the Irish Sea, the Channel, the Bay of Biscay, and the Mediterranean, Adriatic and Black seas. In this country, where the idea that a university should be primarily a research institution is slow in taking root, we can not look for the establishment of such stations far from university centers. The founding of the Carnegie Institution leads us to hope that now America can do her plain duty in the investigation of our adjacent tropical seas. Just where these laboratories should be located may be left to the consensus of opinion of zoologists, if such can be obtained. There seems to be a nearly unanimous agreement that the Tortugas are the best place for one of them. Certainly any one looking at the map and seeing their position in the middle of the out-portal of the great breeding ponds of the Atlantic tropical fauna would predict that here would be one of the best places in the world for a marine station. Twelve years ago Mr. Agassiz named it to the writer as the ideal place for a marine station, and every zoologist that has been there since has brought home the same report. So it clearly *is* an ideal spot, and the first tropical marine station should go to the Tortugas.

It is to be hoped that, in addition, the desirability of establishing a marine station at Jamaico, Porto Rico or another of the Antilles may be considered; and while we are planning a chain of marine stations, certainly the island of Grand Manan or the coast of Newfoundland and Puget Sound should be considered. Also, it would be well to have a party to explore in successive years the fauna of Davis Strait, Hudson Bay, Bering Sea and the Gulf of California, and to report on the feasibility of establishing marine stations at those places. But it seems to me the first step is certainly to establish a laboratory at the Tortugas.

C. B. Davenport.

Chicago,
May 13, 1903.

To the Editor of Science: Although somewhat tardy in my reply to Dr. Mayer's query, I am none the less enthusiastically in favor of the establishment of a marine biological laboratory for research in the tropics. There would be certain advantages in having it within the jurisdiction of the United States, which would narrow the choice of site to Porto Rico, the coast of Florida, or the Tortugas. In the region of Porto Rico the island of Culebra seems especially favorable, and the *Fish Hawk* found good collecting also at Mayaguez. Before a laboratory is finally established I think that these localities should be considered carefully. As to the main coast of Florida and the islands immediately adjoining, a laboratory in most localities of this region would be inaccessible and difficult to provision. Moreover, as I can testify, the water there is frequently in bad condition, becoming milky with fine calcareous material from the grinding of the coral sand by the surf.

Dr. Mayer reports the water at the Tortugas to be very pure; and, as there is a government station there, I infer that means is afforded for frequent communication with Key West, which is easily accessible and would furnish a satisfactory base of supplies. Professor Nutting has mentioned the abundant fauna of the Tortugas, but the one point in which the Tortugas seem likely to excel all other localities has not been emphasized, and that is as a place for the study of the tropical *pelagic* fauna.

It was a search for such a place that led the Johns Hopkins party of 1892 to Bimini, which is on the east side of the Gulf Stream. The Tortugas were considered, and rejected on account of the quarantine for yellow fever there at that time. We arrived at Bimini after a storm with the wind blowing from the southwest, and upon rowing out into the Gulf Stream we found an abundance of pelagic forms that more than satisfied our greatest expectations. But after the wind had returned to normal southeast and had been blowing from that direction a week or so we realized that we had selected the wrong side of the Gulf Stream, for there was a com-

plete change in the pelagic fauna within reach of the laboratory, the catch consisting chiefly of larvæ of forms living upon the Bahama Bank. Reports of the Weather Bureau show that, except during the midwinter months, the prevailing winds at the Tortugas are from east to southeast. That is, they blow diagonally across the Gulf Stream toward the station. This, with a reasonable amount of calm weather, would afford ideal conditions for the study of the truly pelagic fauna, which is the most interesting and the least known. Ordinarily one has to go out in a ship to study this fauna, but at Tortugas, as at Bimini, it would be brought to the door of the laboratory by an ocean current, and at the Tortugas there would be the additional advantage that the wind would generally be blowing across the current toward the laboratory instead of away from it.

If a laboratory is established there I shall certainly endeavor to use it, and I hope that its establishment will not be delayed by any idea of great expenditure. Very good work can be done at such a place with very modest equipments.

ROBERT PAYNE BIGELOW.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
May 26, 1903.

HAVING spent a season in Jamaica I am disposed to advocate that island with almost unqualified commendations as a site for a research laboratory in the tropical Atlantic.

B. W. BARTON.
JOHNS HOPKINS UNIVERSITY,
May 6, 1903.

SHORTER ARTICLES.

THE ARC OF QUITO.

THE following statement concerning a work of international interest and importance is taken from the *Comptes Rendus, Hebdomadaires, des Séances de l'Académie des Sciences*, tome CXXXVI., No. 14 (6 Avril, 1903).*

"The commission formed by the French Academy of Sciences for the scientific control of the geodetic operations on the Equator had a meeting on March 9 to hear the report of M. le Commandant Bourgeois on the work executed during the year 1902." Unhappily, the progress of the work has not been as rapid as was expected last year when the previous report was made. This delay has resulted from two prinicipal causes, the first being the exceptionally unfavorable meteorological conditions. The summits of the mountains were constantly covered with clouds or mist which rendered observations impossible.

Lieut. Perrier remained three months at the station on Mirador, at an altitude of 4,000 meters, and was constantly in the clouds. During his whole stay incessant rains and a furious wind prevailed except at rare intervals. The other parties encountered the same difficulties. At Tacunga, M. Maurain was only able to observe at rare intervals. At Cahuito, M. Lacombe passed many days in the mist and snow without being able to obtain a single observation. M. Lallemand had charge of the reconnaissance and signal building and encountered many obstacles. These unfavorable conditions appeared to have an exceptional character which the reconnaissance could not make known in advance. Ordinarily the season of rain is shorter, and even in the worst months observations are sometimes possible during many hours of the day. Is it possible that the persistent bad weather should be ascribed to the recurrence of volcanic activity which showed itself in the whole of South America after the catastrophe at Martinique?

The volcanoes of the eastern Cordilleras, which ordinarily emit a little vapor, threw out columns of smoke on many occasions, and there were lava flows in the western chain.

Strong earthquake shocks were also felt. These volcanic manifestations did not directly delay the work, but perhaps they were connected with the meteorological conditions which proved to be so serious in delaying the operations.

The second cause of delay was the continued

* Report presented in the name of the commission charged with the scientific control of the geodetic operations on the Equator. (Commissioners; Mm. Bouquet de la Grye, Hatt, Bassot, Loewy; H. Poincaré, Secretary.)

destruction of the signals by the Indians, and also by the whites. These ignorant people imagined that these signals were erected to mark the location of treasure and they not only threw down the signals but they dug deep in the soil all around and destroyed the marks which had been established in order to recover the exact location of the stations. The warning of the government, the commands of the bishops and sermons of the priests were equally unable to prevent this destruction.

We hope that, thanks to the efforts of the authorities and, above all, to the zealous efforts of the president of the republic, such incidents will become unusual. The destruction of signals in a country where communication is so difficult always entails long delays, but, above all, to find on many occasions that the marks had been destroyed after the position of the station had been exactly determined was most disastrous, as it entailed the reoccupation of all the stations from which the one destroyed had been observed. Thus the destruction of the marks at Chujuj, situated in the center of a polygon, made it necessary to reoccupy the four surrounding stations.

Certain signals have been destroyed three times and almost every report from Captain Maurain mentions other cases of destruction. The most unfortunate of these incidents was the simultaneous destruction of the marks at Panecillo, where one of the principal astronomical stations was located, and of the geodetic station of Pambamarca. The geodetic station had not been occupied, and it was necessary to redetermine the astronomical azimuth of the side Panecillo-Pambamarca, a primary operation which had been completed in 1901.

There is great anxiety about the safety of the stations Zagroun and Lanlanguzo at the ends of the line, from which the work to the south will be extended. If these stations are destroyed it will be necessary to redetermine many other stations. Native officers attached to the expedition have been sent to this line to watch the stations and impress on the local political authorities the importance of preserving it from destruction.

In spite of all these difficulties, we have the satisfaction of stating that the operations have been conducted in such a way as to furnish every guarantee of precision. We regret the delay of some months which will undoubtedly increase the expense, but the scientific value of the work will leave nothing to be desired.

Base Measurement.—Two base lines were measured in 1901, one in the center at Riobamba, measured first with a bi-metallic bar and afterwards with the Jäderin wire; the other on the north at El Vinculo measured only with the Jäderin wire. These measurements were made during the preceding year, but since then they have been reduced. A third base will be measured at Payta in the southern section of the arc at the close of the operations.

Astronomical Observations.—The necessary observations have been entirely completed. The latitude of Tulcan (principal station) was determined in February; the determination of the difference of longitude, Quito-Tulcan required much time on account of unfavorable weather; the evenings of the exchange of telegraphic signals, comprising two entire evenings with four joint determinations at the two stations, two joint half evenings, plus five evenings with two determinations at one station and only one at the other. The computation of these observations has not been completed, but the results appear satisfactory. The exchange of observers was not practicable, but MM. Maurain and Perrier determined their personal equations at Quito and will redetermine them when they meet again. The resulting latitudes are as follows, all the computations having been made:

Payta	$-5° 05' 08''.6$
Riobamba	$-1\ 40\ 00\ .9$
Panecillo	$-0\ 13\ 51\ .1$
Talcan	$+0\ 48\ 25\ .6$
Total amplitude of arc	$5° 53' 34''.2$
Amplitude of northern section	$2\ 28\ 26\ .5$

The northern section includes two secondary astronomic stations, Tacunga and Ibarra. Captain Maurain decided first to determine the longitude between the principal station at Panecillo and the observatory at Quito, so as to take advantage of the continuous presence

of M. Gonnessiat at the observatory for the determination of the longitude of the secondary stations. For this purpose M. Maurain, before starting, determined his difference of personal equation with M. Gonnessiat and then determined the difference of longitude between Quito and the two secondary stations, on three evenings, using one chonograph installed at Quito which registered the observations of the two observers. Telegraphic communication was made without a relay. The latitude of Tacunga was determined on four evenings with a meridian circle and the preliminary general mean is 0° 56′ 00″.97. The results of the observations for altitude at Ibarra are not yet reduced.

Geodetic Operations.—The astronomical observations have been completed and the unexpected delay has all been in the geodetic work.

The northern section from the side Zagroun Lanlanguzo includes thirty stations between the two base lines, and of these thirty stations only six or seven remain to be occupied.

The northern observing party has completed the polygon which encloses the El Vinculo base line, except the central station Machines, while the southern party, starting from the line Zagroun-Lanlanguzo to the south of Riobamba, has reached the line Pichincha-Pambamarca, to the north of Quito. Unhappily we must expect to find difficulties at the remaining stations, similar to those already encountered, on account of the climatic conditions.

The azimuths already determined show a very satisfactory agreement and the mean error of closure of the triangles already computed is about one second.

Zenith Distances.—In general, it is not possible to measure simultaneous reciprocal zenith distances, but reciprocal zenith distances have been obtained between all the stations. The preliminary examination of these observations shows that they are very accordant and the refraction seems suitably constant, which fact the steadiness of the objects observed had indicated in advance. This is confirmed by the rigorous simultaneous measures made by M. Maurain at Pambamarca and by M. Gonnessiat at Panecillo. Under these conditions it is possible to execute good geodetic leveling.

Latitudes of the Third Order.—The attention of the observers was called to the necessity of obtaining observations for latitude as often as practicable.

The theodolite with micrometers could not be used, and it was very difficult to transport the meridian circle. After considerable progress had been made the observers received accessories which enabled them to use the theodolite with micrometers in observations for latitude. Captain Maurain observed a secondary latitude at Tacunga with the meridian circle and then made observations for latitude with the theodolite to ascertain the precision to be expected when that instrument was used. The result was sufficiently good to warrant its use for this purpose in the mountains. There is always a systematic difference between observations on north stars and those on south stars, but the errors from many successive nights are always very small.

The observers will soon receive two Claude Driencourt apparatus; this apparatus, which has been described in the *Astronomical Bulletin,* Vol. XVII., gives results of great precision and is very portable, and it can be utilized at the geodetic stations which remain to be occupied, especially in localities where gravity observations will be made. A great number of observations for latitude of the third order have been made with the theodolite, one to the south of Riobamba, one near Riobamba, two around Tacunga, three around Quito (Pambamarca, Pichincha, Corazon) and four around the northern base line.

Gravity.—This portion of the work has not made much progress. The station at Riobamba is reduced, but it still needs the accurate determination of the rate of the sidereal clock. No other observations have been made. It is still undecided what instruments should be used at the secondary stations. The Sterneck pendulum does not appear to present as great advantages as it was at first believed to possess. M. Maurain

thought of using the new thermo-barometric method which has been used on the Atlantic Ocean, but it has been justly stated that this method would not give results sufficiently precise. However, the chief of the expedition has not lost sight of this important question, and we can be assured that it will not be neglected.

Leveling of Precision.—The completion of the work on the railroad towards the plateau between the Andes permits the levels between Guayaquil and the base line at Riobamba to be determined with much greater facility than was possible when the arc measure was begun.

Topographic Work.—A map on a scale of 1/500,000 will be made of the whole intermountain region and special maps on a larger scale have been made in certain localities.

Magnetic Observations.—Magnetic observations have been made at nearly all the stations. They are not yet reduced.

Studies in Natural Science.—Dr. Rivet has continued his studies relating to the natural sciences and has made a number of additions to the museums. He has undertaken the study of the anthropology of the Indian races in this intermountain region.

The following is the program of work during the year 1903:

1. The completion of work on the northern section.

2. The geodetic observations on the southern sections and more or less of the section Riobamba-Cuença, comprising besides azimuth observations the determination of the latitude 'a la seconde ronde' at each station if possible.

3. A secondary latitude at Cuença and the difference of longitude Cuença-Riobamba (or Cuença-Quito) if telegraphic connection between the former stations can not be made without delay.

4. The magnetic observations as heretofore.

5. The beginning of the levels of precision.

There remains for the following years the geodetic work on the section Cuença-Payta, the pendulum observations, and the connection, if possible, by geodetic observations of the island of Puna, with the meridional chain of triangulation, with a complete astronomical station on Puna.

Isaac Winston.

QUOTATIONS.

THE NEW YORK STATE SCHOOL OF FORESTRY.

When New York established a School of Forestry, to make sure that it should not fall into the hands of politicians and be exploited for 'what there was in it,' it was lodged under the shelter of Cornell University. It was deemed advantageous to make this arrangement for other reasons also, and particularly in order that the teachers and students should have access to the library and laboratories and lecture rooms of the university proper, where the cognate sciences of botany, chemistry, mineralogy and various kinds of engineering are taught. The university chose a professor of forestry of the highest repute, Mr. E. B. Fernow, and placed him in charge of the important work which had been assigned to it, and the state set apart certain forest lands which it owned, in order to impart the needed instruction to students. The annual reports of Professor Fernow have been published and circulated at the state's expense, and have been highly praised by all competent to form an opinion. We have never seen an unfavorable comment upon them by any expert in forestry.

The state also made an annual appropriation for its School of Forestry. That of 1902 was for $10,000, where $30,000 had been asked for. This year the appropriation was vetoed by the governor, and now the attorney-general has been requested by certain summer residents of the Upper Saranac Lake region to bring an action to annul the 'grant of forest lands to Cornell University'—so the dispatches read. Naturally, the newspapers have fallen into the habit of considering the university the beneficiary of both the grant and the appropriation. This is not the first time that the mistake has been made, although the fact is that the state is indebted to the university in respect of this school. The university has no pecuniary interest in the School of Forestry that is not common to all citizens of New York. What is at the bottom of this rage against the School of Forestry it is difficult to see, unless it may be the mere objection of campers, hunters and summer residents. The objectors, whoever they may

be, say that the state constitution is violated by the removal of timber from the ground 'for purely commercial purposes.' There has been no removal of timber for any such purpose. If the science of forestry is to be taught at all, it must be done by first clearing some portion of the land for the reception of new growth. The timber removed would naturally be sold on the general ground of economy and for the special purpose of reimbursing the state for the cost of cutting and hauling. The only question which now confronts the state is that of continuing the scientific instruction in forestry which it has begun or of abandoning it.—The N. Y. *Evening Post.*

AGE OF GERMAN UNIVERSITY PROFESSORS.

DR. F. EULENBURG, privat-docent in the University of Leipzig, has published in the *Jahrbücher für Nationalökonomie und Statistik* a lengthy article dealing with the age of the active full professors in the universities of Germany as also of the German universities in Austria and Switzerland. It is practically exhaustive, only about two per cent. of the complete data being wanting, so that it covers 1,288 professors for the winter term of 1890–91, and 1,429 for the winter term of 1901–02. According to these statistics, the average age of the full university professors at present is 53.4 years, which is two years above what it was a decade ago, when it was 51½ years. The highest average age is found at the ten Prussian universities, where it is 54.5 years, and the lowest average in the three universities of Switzerland, where it is 51.8. It is significant that the smaller universities exhibit a smaller average than the larger; this is explained by the fact that usually men do not gain an entrance into the faculties of the larger until they have been tried and found approved in the smaller. In different departments the average varies considerably. In the case of the 201 theological professors it is 54.2; of the 226 law professors, 54.2; of the 295 medical professors, 54.8; of the 707 men in the several departments of the philosophical faculty, 53.1. That the average among the medical men should be the highest is readily explained by the fact that the rush to this department is especially great, and that the number of assistant professors and privat-docents is very large. On the other hand, the law faculties have not been attracting so many candidates, and the chances for earlier promotion are accordingly greater. The highest averages are reported from Berlin, Königsberg, Munich and Leipzig; which can readily be explained in the case of the first, third and fourth, as these leading universities are the Ultima Thule of the German savant's ambition. The youngest full professors are found in Bonn, Heidelberg, Vienna and Strassburg, in the non-theological faculties, and in Tübingen, Marburg, Innsbruck, Erlangen and Giessen in all departments. There are only two full professors under thirty, both in the law department, one in Tübingen and the other in Bern. About four per cent. of the professors continue in the harness after they have passed their seventieth year, but it should be remembered that in Austria, as in the German provinces of Russia, professors are retired by law when they reach this age. Eulenburg suggests that the German states pass a law giving the incumbent of an academic chair the right to retire at the age of sixty-five with a pension, and making this compulsory, except in rare cases, at the age of seventy, but in each instance, in the latter case, making the incumbent Professor Emeritus and giving the 'Lehrauftrag' to a younger man. This, he declares, would be justice to both students and professors. His discussion has an added interest when compared with the paper published in 1876 by Laspeyres on the same subject.—*Medical News.*

PROGRESS OF THE CONCILIUM BIBLIOGRAPHICUM.

DR. HERBERT HAVILAND FIELD is now in this country in connection with the *Concilium Bibliographicum,* and will visit various institutions, in order to report in person on the progress of the concilium, and to enter into communication with all who are interested in bibliography in the various lines of natural history. His address during his stay in America will be 106 Columbia Heights, Brooklyn, New York.

The turning point has been reached in the history of this really great undertaking. The chief support has come through the generosity of the Swiss government, and it is hoped that the American government and some of the leading American institutions will unite in placing this work upon a secure foundation. Naturally one of the first questions asked is how the undertaking is regarded abroad, and why it should receive the united support of workers in the various lines of natural history. There are several striking proofs of the esteem in which the concilium is held on the continent. Through the death of Professor Carus, who has given his entire life to bibliography, almost without remuneration, a vacancy has occurred which the concilium has been invited to fill. It is a matter of continuing the zoological bibliography conducted by one who has been universally acknowledged to be a master in his subject and which reaches back without interruption to the year 1700. Before agreeing to undertake to carry on this work, the concilium is brought to face obligations which it can not fulfill without new support. At the same time the botanists on the continent, impressed with the thoroughness of the work of the concilium, at the international conference held in Leiden on April 16, voted to place the editorship of the well-known botanical bibliography in the hands of the concilium, as soon as funds could be obtained for doing the work. In both these cases, zoology and botany, it is only a small portion of the entire expense that is needed, but failure to obtain this comparatively small aid will make it impossible for the concilium to undertake these new duties. Meanwhile a number of European geologists are awaiting the results of these negotiations, with a view to establishing a geological section of the concilium similar to that of other parts of the institution. This endorsement from workers in three entirely separate fields, arrived at entirely independently, is so striking that it needs no further comment. Never was the conjunction of circumstances for securing a thoroughly adequate bibliography of an entire group of natural sciences more marked. It is hoped, therefore, that the effort that Dr. Field is now making here will be crowned with success.

The special needs of the concilium are, in the order of importance: $3,500 for improvements in the Zurich plant, especially for the acquisition of a linotype printing machine; $4,000 for the liquidation of an accumulated debt; and at least $1,000 additional for current expenses.

Dr. Field especially invites criticisms and suggestions upon the work as it is now being carried on. From several persons the criticism has been made to the present writer that the cards accumulate too rapidly and are somewhat difficult of arrangement. This difficulty, in the nature of *embarras de richesse,* has been felt in many laboratories. It will be readily obviated, first, by the introduction of the guide cards which are supplied by the concilium, and which make the arrangement of the titles a purely mechanical matter; second, it is proposed, wherever desired, to limit the number of cards sent out which relate to certain local faunæ and are of purely local interest. These, and any other matters of criticism which may arise, Dr. Field, as director of the concilium, will be glad to receive and carefully consider as suggestions for improvement of the service. All those who are using the cards appreciate that, whatever criticisms as to details may be made, the concilium is doing a magnificent work, a work far surpassing in accuracy and fulness and readiness of arrangement that which has been done or is now being done elsewhere. Many of the former critics and opponents of the concilium are now recognizing its superiority, and it is certainly to be most earnestly desired that the United States should strongly support an undertaking which has been conceived and carried out only through the persistence, energy and devotion of an American.

Henry Fairfield Osborn.

CENTENNIAL CELEBRATION OF THE BIRTHDAY OF JUSTUS VON LIEBIG.

On the twelfth of May, by invitation of the New York Section of the Verein Deutscher

Chemiker, the members of the American Chemical Society, the Society of Chemical Industry and the Chemists' Club participated in a celebration in memory of the illustrious investigator and chemist, Justus von Liebig, who was born one hundred years ago.

The societies met in the assembly hall of the Chemists' Club and listened to addresses by Dr. Ira Remsen, president of Johns Hopkins University; Professor Wm. H. Brewer, of Yale; Dr. Carl Duisberg, vice-president of the Verein Deutscher Chemiker and managing director of the *Farbenfabriken* of Elberfeld, Germany.

The exercises were opened by Dr. Hugo Schweitzer, chairman of the Verein, who welcomed the assembly and foreign guests in a very appropriate address, and introduced the speakers.

Dr. Remsen outlined the early life of Liebig, mentioning his unpromising inaptitude for study at school, which resulted in giving it up and devoting himself to chemistry; his first interest in which was aroused by the study of colors and dye-stuffs. Later, while at a country fair, he saw an exhibition of Pharaoh's serpents, accompanied by some chemical operation connected with their preparation which led eventually to his study and investigation, while attending the lectures of Gay Lussac at Paris, of the cyanides, cyanates and fulminates. This work resulted in his introduction to Gay Lussac, who admitted him to his private laboratory. He was appointed a professor at the University of Giessen, in his twenty-first year, 1824, where his laboratory was of the crudest character, not much better than a barn without flooring; but from this modest beginning, with only six or seven students, his work grew and his reputation spread; a new laboratory was built and students came to it from all quarters.

During the twenty-eight years at Giessen the activity of Liebig and the work he accomplished were enormous; and he can be truly considered the greatest chemist of that time. His publications in scientific journals amounted to more than two hundred papers, in addition to his works on agriculture, organic chemistry and analysis; besides acting as editor of several scientific journals.

Coming to personal reminiscences of the time when he attended the lectures of Liebig at Munich, Dr. Remsen described the difficulty he experienced as a student in attempting to harmonize the old system as taught by Liebig, with the new as taught by his assistant, Volhard. Speaking of his methods, he said that all Liebig's lectures were profusely illustrated by experiments, many of them so elaborate as to be unthought of in the present-day lecture room—metallurgical experiments requiring wind furnace, and many others which the speaker said he would now hardly believe could have been done on the lecture table if he had not preserved his note-book filled with rude drawings of all the apparatus used.

Liebig was fond of a little dramatic effect, and took some care to bring his lectures to a climax with the most effective experiment, whether with a big flash of flame or an explosion or otherwise; and while the present method is more severe and straightlaced, the speaker said he was not certain that the impressions made and the train of thought aroused by Liebig's method were not very effective.

It was extremely difficult to get admission to Liebig's laboratory as a student; in fact, it was one of his conditions, on accepting the professorship at Munich, that he should not give his time or attention to students. In appearance, Liebig was large of stature and of fine bearing; one of nature's noblemen, but very emphatic in berating his assistants when the experiments went wrong, his language on such occasions being more remarkable for condensed energy than for rhetorical elegance.

Professor Brewer, who is the oldest living pupil of Liebig in this country, and who has been his devoted follower in the line of agricultural chemistry, told of his enthusiastic desire to study under him, aroused by reading a translation of his work on agriculture in 1846. A few years later he went abroad, and with letters of introduction went to Munich. Here he found Ogden Rood, afterward pro-

fessor of physics at Columbia University, who offered at once to introduce him to Liebig, and assist in every way toward the desired end. But Rood advised him not to use his letters of introduction; not to call Liebig 'professor,' but 'Herr Baron'; to have plenty of assurance, and not to spare flattery. With this preparation the introduction was brought about and Brewer stated his mission. Liebig assured him that he would do better to go somewhere else. He said: 'I will give you no attention; no attention.' This assurance met every advance until finally the speaker said: 'I told him I have come three thousand miles to sit at the feet of the greatest teacher of chemistry in Europe and I am going to remain here.' 'Well,' said Liebig, 'see Mr. Meyer.'

He saw 'Mr. Meyer,' and a place was set apart in the laboratory for the new student, who remained there a year, but actually received practically 'no attention,' except when he showed some organic crystals to him which had the appearance of potassium nitrate, and were so pronounced by Liebig on sight. The effort to convince him that they were organic was followed by a sound berating for 'contradicting,' which was later followed by demonstrating to the great professor that no contradiction had been intended, and that the crystals were in fact 'very peculiar.' Professor Brewer's address was full of personal interest and was followed with the closest attention.

Dr. Carl Duisberg read a paper describing the influence of Liebig on chemical industry, his teachings resulting in that knowledge of the importance of scientific method which has so largely displaced the 'rule-of-thumb' man by trained chemists in all the great chemical industries of Germany; and more or less in other countries. Liebig's influence was exerted chiefly on the organic chemical industries, and much of their progress is due to his activity and energy while at Giessen.

"A staff of his pupils making their way to all quarters of the globe disseminated his ideas in assisting agriculture and the chemical industries, and as the first systematic teacher of laboratory methods, the credit is justly due him for an influence which can hardly be measured or described."

Among those assembled to honor the memory of the great chemist were Mr. Ivan Levenstein, of Manchester, England, president of the Society of Chemical Industry, and his son, who represents the Levenstein Company, limited, in this country; Dr. Liebmann, also of Manchester; Drs. H. Reisenegger and F. Backe, of the color works at Höchst am Rhein; Dr. Teichmann, of Kuhnheim Works, Berlin; F. Bayer of Elberfeld; W. Haarmann and son of Holzminden, German; also Dr. T. J. Parker, chairman of the American Chemical Society; Dr. McMurtrie, ex-president of the same society; Professors W. H. Hallock and C. E. Pellew, of Columbia University; Charles A. Doremus, William Jay Schieffelin and others.

Durand Woodman.

*THE DALTON CELEBRATIONS AT MANCHESTER.**

The Manchester celebrations in connection with the centenary of Dalton's atomic theory began on Tuesday afternoon, May 19, when Professor F. W. Clarke, chairman of the International Commission on Atomic Weights, delivered the Wilde lecture on the 'Atomic Theory' to the Manchester Literary and Philosophic Society. Addresses were presented on behalf of the Royal Society and the Chemical Society, and a message was received from the Russian Physico-chemical Society. In an admirable discourse Professor Clarke sketched the history of the atomic theory from its first conception in the minds of Greek philosophers down to the present day. He pointed out the directions in which the atomic theory would probably develop, but declared that the problem of matter would never be solved until the atomic weights of the elements had been finally settled. "Who," he asked, "will establish the Dalton Laboratory for pure research, and so give the work which he started a permanent home?"

In the evening the Literary and Philosophical Society gave a dinner, at which the prin-

* From *Nature.*

cipal guests were Professors Clarke and van't Hoff, Professor A. E. Armstrong, Mr. Brereton Baker, Professor P. F. Frankland, Mr. Vernon Harcourt, Dr. Harden, Sir James Hoy, Professor Kipping, Dr. W. H. Perkin, Sr., Sir William Ramsay, Professor Emerson Reynolds, Sir Henry Roscoe, Professor Smithells, Dr. Scott, Professor Thorpe and Professor Tilden.

In proposing the toast of the evening, the 'Wilde' medallist—Professor Clarke—and the Dalton medallist—Professor Osborne Reynolds—Sir Henry Roscoe said that Dalton's atomic theory and Joule's discovery of the mechanical equivalent of heat reflected more distinction on Manchester than the city's association with the cotton industry or with the Ship Canal.

On Wednesday morning a special meeting of the Owens College Chemical Society was held to offer an address to the great Dutch chemist, J. H. van't Hoff, now professor at the Berlin University. Professor Dixon was in the chair. The address was presented by Mr. Norman Smith, a former student under Professor van't Hoff. The professor, who was enthusiastically received, said the question was often asked, nowadays, whether the atomic theory had not outlived its utility. His reply was that, in dealing with natural phenomena, with states of unstable equilibrium, the atomic theory was indispensable for essential explanations. He had come to regard the conception of the carbon atom as the center of a tetrahedron as childish, but it contained the germ of a profound truth, the solution of which must be left to the future. He suggested that valency was due to an equilibrium. The four mutually repellent 'electric atoms' of Helmholtz were kept in equilibrium by their attraction for the carbon atom at the center.

Later in the morning Earl Spencer, Chancellor of the Victoria University, conferred the honorary degree of Doctor of Science on Professor Clarke and Professor van't Hoff, who were presented by Professor Dixon. After the conclusion of the ceremony Professor van't Hoff laid the first stone of the proposed extension of the Owens College Chemical Laboratories, and was presented, as a memento of the occasion, with a silver trowel by the College Chemical Society. The celebrations were concluded by a soirée held at the Owens College on Thursday night, when Dr. Harden gave an interesting account of John Dalton, and many Dalton relics were exhibited by the Manchester Literary and Philosophical Society, Professor H. B. Dixon, Mr. Theodore Neild, Mr. G. W. Graham and Mr. G. S. Woolley.

TRIGONOMETRIC SURVEY OF BRAZIL.

THE Brazilian government has provided for the mapping of its territory on a scientific basis. Last year the congress appropriated the necessary funds for commencing the work, and a commission of which Colonel Francisco de Abreu Lima is President, was to leave Rio early in May for the state of Rio Grande do Sul to make a reconnaissance of the first zone to be triangulated.

The scheme as far as at present outlined, includes the measurement of bases at Porto Alegre and Uruguayana, and the connection of these two cities by triangulation. This will give an arc of about six and one quarter degrees of longitude in about latitude 30° south.

The Superintendent of the U. S. Coast and Geodetic Survey has been requested by the commission to supervise the preparation of the necessary tapes and accessories for the measurement of the bases.

SCIENTIFIC NOTES AND NEWS.

DR. W J MCGEE has been appointed chairman of the committee of the International Geographical Congress of 1904, succeeding General A. W. Greely, who has resigned owing to ill health and the pressure of official duties.

THE University of Marburg has conferred its honorary doctorate on Mr. Geo. F. Kunz, of New York City.

M. HENRI BECQUEREL, Paris, and Professor A. Righi, Bologna, have been elected honorary fellows of the Physical Society of London.

DR. MAX NOETHER, professor of mathematics at Erlangen, has been elected a foreign member of the Academy of Sciences at Buda Pesth.

Lady Huggins and Miss A. M. Clerke have been elected honorary members of the Royal Astronomical Society.

The commencement address at the graduating exercises of the Worcester Polytechnic Institute is to be given by O. H. Tittmann, director of the United States Coast and Geodetic Survey.

At a special meeting of the Physical Society, London, held on June 5, at University College, Professor E. Rutherford, of McGill University, read a paper on radioactive processes.

Mr. Andrew Graham, who has for nearly forty years held the office of chief assistant at the Cambridge Observatory, is retiring at the age of eighty-eight.

Dr. Otto Bütschli, professor of zoology and paleontology at Heidelberg, has celebrated the termination of his twenty-fifth year of service as professor at the university.

Dr. William Osler, professor of medicine at the Johns Hopkins University, sailed on May 29 to England, where he will remain until the end of September.

The National Geographic Magazine states that Dr. A. Graham Bell resigned the presidency of the National Geographic Society at a meeting of the board of managers, on May 15. Dr. Bell stated that owing to the pressure of work he found it impossible to give to the society the thought that the position of president demanded. The resignation of President Bell was accepted by the board with profound regret, to take effect on the election of his successor. Dr. Bell was appointed chairman of a committee of three to consider and nominate a successor. The other two members of the committee, appointed by the president, are Dr. Willis L. Moore, chief U. S. Weather Bureau, and Mr. G. K. Gilbert, U. S. Geological Survey. As no election will be made until the fall, Dr. Bell will continue as president of the society for some months.

A statue of the chemist, Kekulé, by the sculptor Heinz Everding, has been unveiled this month at Bonn.

John F. Hicks, assistant botanist of the Ohio Agricultural Experimental Station, died at Wooster, Ohio, on June 1.

Dr. Milan Sachs, a young Viennese physician, has died from plague at Berlin. He had studied the disease at Agram and other Balkan cities, and went to Berlin a few weeks ago to continue his researches at the Bacteriological Institute, where he became infected.

M. Gaston Dubois Desaulle, who was on a voyage of exploration to the West Coast of Africa, has been killed by the Galadils.

We regret also to record the deaths of Dr. Friedrich Deichmüller, professor of astronomy at Bonn, and of M. François Crépin, director of the Botanical Garden at Brussels.

There will be a civil service examination on July 15 for the position of chief of the Division of Pharmacology, Bureau of Public Health and Marine Hospital Service, the salary of which is $3,600. There will be no scholastic tests, and competitors will not be required to be assembled for examination, which will be based on technical training, professional experience and publication.

There will also be a civil service examination on June 3 for the position of illustrator in agrostology in the Bureau of Plant Industry, Department of Agriculture, with a salary of $720.

Mr. Carnegie's gift of $1,000,000 to the four national engineering societies and the Engineers' Club for a building has been accepted at a meeting of the representatives of the five organizations, and plans have been made for a joint committee consisting of three members from each organization. This committee will prepare plans for a building to be erected on Thirty-ninth St. Efforts are being made to secure funds for the purchase of the land, and we learn from *The Electrical World* that a number of subscriptions have been received by the American Institute of Electrical Engineers including $5,000 from Dr. Elihu Thomson and the Westinghouse Electrical Company, $2,000 from Mr. Frank S. Sprague and $1,000 with a contingent $1,500 from Mr. J. G. White.

THE College of Physicians of Philadelphia will remove from its present building on Thirteenth and Locust Sts., and will erect a new building on Twenty-second St.

THE corner stone of the new observatory at Amherst College will be laid at noon on June 23, in connection with the commencement exercises.

THE steamship *Gauss* of the German Antarctic Expedition, under the command of Professor von Drygalski, has arrived at Natal on the way to Cape Town.

THE forty-first Annual Convocation of the University of the State of New York will be held in the Senate Chamber, Albany, June 29 and 30.

IT is stated in *Nature* that the annual congress of the Southeastern Union of Scientific Societies will be held at Dover, June 11–13. On Thursday evening, June 11, the president-elect, Sir Henry H. Howorth, F.R.S., will deliver the annual address. The following papers will be read on June 12: 'Atmospheric Moisture as a Factor in Distribution,' by Mr. A. O. Walker; 'Experiences of Leprosy in India,' by Dr. Jonathan Hutchinson, F.R.S.; 'The Diminution and Disappearance of Southeastern Flora and Fauna within the Memory of Present Observers,' by Captain McDakin and Mr. Sydney Webb; 'The Seedlings of Geophilous Plants,' by Miss Ethel Sargant; 'The White Chalk of Dover,' by Dr. Arthur Rowe; 'A Late Keltic Cemetery at Harlyn Bay,' by Rev. R. Ashington Bullen. On June 13 Mr. A. T. Walmisley will lecture on 'International Communication.'

THE Lake Laboratory of the University of Montana will open on July 13 and will continue for five weeks, after which opportunity will be given for research work. Professor M. J. Elrod is director of the station and has charge of the work in botany and entomology. Mr. Morris Ricker has charge of zoology and photography and Mr. P. M. Silloway of ornithology and nature study. The field laboratory is located on the bank of Swan River at its outlet into Flathead Lake. This location affords a harbor for boats and a camping site for the tents of those attending. The adjacent region contains forests, ponds, lakes, swamps, cultivated fields, mountains, rivers and ravines. It is rich in animal and vegetable life. The lake offers opportunities for collecting, and presents some beautiful scenery. East of the lake the Mission range comes abruptly to the water's edge. The range slopes from the Swan River on the north to the high peaks, ten thousand feet, at the southern end, and its scenery is wild, rugged and grand, truly Alpine in character. West of the lake are the Cabinets. Near the station Swan Lake, Rost Lake, Echo Lake, and other waters, are easily accessible. Daphnia Pond, a few minutes' walk from the station, is rich in pond life, while Estey's Pond, about as far again, is fully as productive. The Swan range is easily accessible from the station, and Alpine summits are annually visited. The station is not difficult of access. The stage and boat rides are easy, with charming scenery constantly in view. The building is a convenient out-door laboratory, with tables for a dozen students. The station work has entirely outgrown the building. Many of the lectures are given out of doors in the yard, and the fine summer weather permits of much laboratory work out of doors.

LORD AVEBURY read a paper at the meeting of the Geological Society, London, on May 27, on the formation of mountains. According to the report in the London *Times* he said that experiments had been made long ago by Sir J. Hall, and afterwards by Daubree, Ruskin, Cadell and others, by arranging layers of cloth, clay, cement, etc., and studying the folds and fractures which resulted when they were compressed. In all these experiments, however, the pressure was in one direction only, whereas it was obvious that if mountains were due, at any rate in part, to the contraction of the earth, in nature the contraction and consequent pressure took place from all sides. Lord Avebury said that he, therefore, provided himself with a square case compressible on all four sides at once. In the central space he arranged layers of sand, cloth, etc., and compressed them, thus throwing them into folds. He then took in each experiment

four casts in plaster of Paris, beginning from the top, and these casts were exhibited to the society. They presented an interesting analogy to actual mountain districts, though, of course, they did not show the results of subsequent denudation due to rain and rivers. It had long been observed that mountainous districts showed two sets of lines at right angles to one another. Any one who would glance at a map of Scotland would see this clearly. One set was represented by the Great Glen, with the lochs and valleys parallel to it, such as the Minsh, Loch Awe, Loch Fine and many others; the second series at right angles to it by Loch Shin, Loch Moree, the Sound of Mull, etc. This characteristic of mountain regions had long been known, and there had been discussions as to whether the folds were simultaneous or successive. Lord Avebury's casts showed this feature very clearly, and it was evident that the cross foldings took place simultaneously.

Investigations of artesian and other underground waters and of springs will be conducted in the following states during the coming field season: *Maine*—Professor W. S. Bayley will collect data in regard to deep wells by correspondence and by field work in the islands along the coast. He will be assisted by Mr. W. C. Washburn. *New Hampshire*—The occurrence of underground waters and of springs will be studied by Mr. J. M. Boutwell, who has already entered into communication with well owners at many points in the state. *Vermont*—Work on underground waters and springs in this state will be conducted by Professor George H. Perkins in connection with his work as state geologist. *Massachusetts and Rhode Island*—These states have been divided into two districts, the northern district including the northern and western portions of Massachusetts, and the southern including southeastern Massachusetts and Rhode Island. The wells and springs of the former will be investigated by Mr. Lawrence LaForge, and those of the latter by Professor W. O. Crosby. *Connecticut*—The services of Professor H. E. Gregory have been secured for the investigations of underground water and springs in this state. He will probably have one or more assistants in the work. *New York*—Two problems are under investigation in this state; the first is an investigation of the geology and water resources of Long Island by Messrs. M. L. Fuller, A. C. Veatch, W. O. Crosby, and several assistants; the second relates to the occurrence, composition and economic value of the spring waters of the state. The latter investigation will be conducted by Mr. F. B. Weeks, in cooperation with Dr. A. C. Peale on the statistical and chemical sides of the problem. *New Jersey*—The work in this state is being conducted in cooperation with the State Geological Survey. It is expected that the artesian well investigations will be completed during the summer, and that a report will be prepared by Mr. G. N. Knapp during the fall and winter. *Georgia*—Mr. S. W. McCallie, assistant state geologist, will probably complete his investigations and prepare a report on artesian and underground waters in the state. *Alabama*—Professor E. A. Smith, state geologist, will continue his investigations of the occurrence of underground waters. *Mississippi*—The work in this state, which has been going on for some time, will be continued by Mr. L. C. Johnson. *Kentucky and Tennessee*—Dr. L. C. Glenn will undertake an examination of the portion of the Mississippi embayment area lying within the limits of these states, with the special object of determining its underground water resources. *Arkansas*—The investigations in this state consist of correspondence with well owners and drillers and of field work along the contact of the Paleozoic rocks with the embayment deposits in the northern part of the state. *Missouri*—Professor E. M. Shepard will carry on investigations relating to deep wells and springs, with a view to preparing a report at an early date. *Iowa*—Professor W. H. Norton will continue his studies on deep wells, and will prepare a report on the artesian waters of the state. *Minnesota*—Professor C. W. Hall will complete a report on the water resources of Minnesota, and will probably investigate new developments along similar lines, as they occur. *Wisconsin, Illinois and Upper Michigan*—The

investigations in these states will cover all those areas in which artesian waters are known to occur, as well as adjacent portions of Illinois and the Upper Peninsula of Michigan. Mr. A. R. Shultz will have charge of the work and will probably have one or more assistants. *Michigan*—The work in this state is conducted in cooperation with Dr. A. C. Lane, state geologist, the field work being in charge of Mr. W. F. Cooper, who will spend a considerable part of the summer in investigation of the underground waters of the state.

UNIVERSITY AND EDUCATIONAL NEWS.

AT the meeting of the board of trustees of the Leland Stanford, Junior, University, held on June 1, Mrs. Leland Stanford resigned and surrendered all the powers and duties vested in her by the terms of the grant founding the university, under which she had complete control. That control is now vested in the board. Mrs. Stanford will be elected a trustee, and will be elected president.

THE total appropriation made to The Pennsylvania State College by the legislature of 1903 and recently approved by the governor was $250,805.55. Of this amount $100,000 is for the purpose of assisting in the erection, equipment and furnishing of a building for the Department of Agriculture, while $150,000 additional are virtually pledged by the attachment of a proviso requiring the trustees of the college to file with the auditor general plans, specifications and estimates satisfactory to him showing that the entire cost of the building and equipment will not exceed $250,000.

THE plans of Messrs. Cram, Goodhue and Ferguson, of Boston, have been accepted for the new buildings of the West Point Military Academy, which are to number twenty-one.

LORD IVEAGH has given £40,000 to Trinity College, Dublin, for building and equipping scientific laboratories.

ACCORDING to the London *Times*, after a great deal of consideration and many consultations with the colleges at Manchester and Liverpool, the council of the Yorkshire College have at last agreed upon the principles upon which the charter for the proposed new Yorkshire University should be based. These are that the Yorkshire College be merged in the university; that the university be founded on a non-federal basis, but that it be empowered to affiliate other institutions; and that the university be governed by a court of governors and by an executive council. Substantial agreement has been arrived at between the three colleges on some important matters, such as that of a common matriculation examination for all the three universities of Yorkshire, Manchester and Liverpool, and provision has been made for a joint board to be constituted from the three universities to deal with such questions. With regard to affiliated institutions, it is provided that attendance at courses of study in such institutions may be accepted by the university in place of such part of the attendance or courses of study at the university as may from time to time be determined. It is considered that the additions to the staff and equipment of the college essential to the proper carrying on of an independent university will require a minimum additional expenditure of about £7,000 a year, while extensive additions will also be required to the college buildings for the proper housing of some of the departments. The coal-owners of Yorkshire have decided to erect a separate building for the mining department, and have collected a sum of £5,500 for the purpose. The council of the college are desirous also of completing the main block of the college, and it is estimated that this would cost about £60,000. Though a canvass for the necessary funds has not yet been instituted, three friends of the college have each promised £5,000, while a fourth has promised £2,000. The Clothworkers' Company of London, who have already proved munificent benefactors of Yorkshire and the Yorkshire College, have added to their previous generosity by offering to transfer to the new university as its absolute property the whole of the buildings and equipment of the textile industries dyeing and art departments, which are at present held in trust by the college for the Clothworkers' Company, and which have cost that company about £70,-

000. Attached to the offer is a condition that these departments shall be recognized as integral parts of the university. The company has also promised to grant in perpetuity to the university for the maintenance of these departments an annual sum of not less than £4,000. This means a gift to the university of a capitalized sum of upwards of £200,000.

According to the *Hochschulnachrichten* the attendance at the universities of the German empire last winter was 40,661, of whom 36,652 were matriculated. The number of matriculated students in the Austrian universities was 16,125. The number of students in the German technical schools was 13,049 and in the Austrian schools 6,451. These figures, however, do not include the attendance at the schools of agriculture, forestry, veterinary surgery, mining and commerce. The number of foreigners in attendance at Vienna was 1,386 and at Berlin 1,085. There were last year 1,253 foreigners in attendance at Paris.

The council of Trinity College, Dublin, has recommended that the senate approve the admission of women to that institution and the abolition of the compulsory study of Greek.

Joint ceremonies of the inauguration of Dr. John Huston Finley as president of the College of the City of New York and the laying of the cornerstone of the new buildings being erected on the site bounded by One Hundred and Thirty-eighth and One Hundred and Fortieth Streets and St. Nicholas Terrace and Convent and Amsterdam Avenues are being arranged by the board of trustees. The installation ceremonies will take place at 10:30 a. m. on October 1. President Roosevelt and ex-President Cleveland will make addresses. The cornerstone of the new buildings will be laid at 3:30 in the afternoon, and addresses will be made by Mayor Low and others.

Rev. H. W. McKnight has resigned the presidency of Pennsylvania College, at Gettysburg.

Professor William R. Ware, from 1860 to 1881 professor of architecture in the Massachusetts Institute of Technology and since then professor at Columbia University, has retired from active service and will become professor emeritus.

Appointments at Cornell University have been made as follows: J. I. Hutchinson and Virgil Snyder, assistant professors of mathematics; J. S. Shearer and Ernest Blaker, assistant professors of physics; W. N. Barnard, assistant professor of machine design; C. S. Hirshfield, instructor in experimental engineering; R. Stevenson and I. Baum, assistants in chemistry; L. O. Veser and R. C. Fenner, assistants in physics.

Mr. J. C. Pearson, A.B. (Bowdoin, 1900), now graduate student at Harvard University, has been appointed instructor in physics and mathematics in Bowdoin College.

Miss Ida Evans, who was graduated from the Woman's College of Baltimore in 1902, has been appointed instructor in biology in Rockwood College. Miss Bertha May Clark, instructor in physics at the Woman's College, Baltimore, has been awarded the graduated fellowship offered annually to an alumna. Miss Clark will study spectrum analysis and advanced mathematics at the University of Göttingen.

Among the twenty-two fellowships awarded at the Johns Hopkins University, the following are in the sciences: Samuel J. Allan, of Montreal, Canada, physics; James Barnes, of Halifax, Nova Scotia, physics; Walter Buckingham Carver, of Stewartstown, Pa., mathematics; August Ernest Guenther, of Sandusky, O., physiology; Elliot Snell Hall, of Jamestown, N. Y., chemistry; Arthur Isaac Kendall, of Somerville, Mass., pathology; Charles Kephart Swartz, of Baltimore, geology; David Hilt Tennent, of Janesville, Wis., zoology; Rheinart Parker Cowles, the Adam T. Bruce fellow in biology.

Nine fellowships have been awarded at Bryn Mawr College, including Carrie Alice Mann, of South Weymouth, Mass., mathematics; Lillian Cohen, of Minneapolis, Minn., chemistry; Ellen Terelle, of Minneapolis, Minn., biology.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 19, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*FUNCTIONS OF TECHNICAL SCIENCE IN EDUCATION FOR BUSINESS AND THE PROFESSIONS.**

"* * * *to write now the reforming of education* * * * *one of the greatest and noblest designs that can be thought on, and for the want whereof this nation perishes.* * * *"—Milton, 'Tractate.'

THE most remarkable and impressive movement of a period which has been well named the 'wonderful century' was one which, from early and feeble beginnings, had been for generations slowly developing, and in rate of motion accelerating, until we to-day see it, in tremendous magnitude and power, affecting every department of human life. This movement causes progressive and cumulative changes in the methods and the products of the labors of the scholar and of the unskilled laborer, of the professional and of the mechanic, of the agriculturist and of the merchant; it changes the views and the studies of the historian, of the philosopher and the psychologist, of the business man and of the educator. It is the advance of the scientific spirit and method into all the fields of human learning and exertion. Scientific method is now dominant in all branches of human life.

This great change commenced with the earliest endeavors of thoughtful men to acquire knowledge by direct appeal to nature and experience. It acquired impetus as the experimental method and the spirit of research began sensibly to enrich our stores of learning and to yield their fine returns in the natural sciences. It assumed its firm grasp upon men's thought and controlled their work when invention and discovery and the upbuilding of new sciences impressed upon the minds of all sorts and conditions of men the fact that its methods were the only direct and sure

* An address at the dedication of 'Engineering Hall,' Iowa State College, May 22, 1903.

ways to achievement. Those methods are simple and even axiomatic in principle.

Science, *scientia,* is knowledge, and its significance became evident immediately it was seen that such an idea is the opposite of speculation, that the determination of a fact and its exact identification by suitable methods was the first step to further and exact knowledge of phenomena, and that this process and its result, the discovery of the laws governing facts in sequence, are the antipodes of the ancient method of primary appeal to the imagination, with later endeavor to find evidence sustaining the fairy tale thus evoked from the inner consciousness.

Wherever work is to be accomplished, the fact is the first requirement preliminary to action, and the controlling law is next to be discovered, in order that it, and every other agency of nature as well as of art, may be directed to the furtherance of the purpose held in view. The scientific method is as fundamental in education as in any other system of application of energy to useful result. A scientific training is an essential, a fundamental, element of all professional education, and systematic training, scientific training, is the direct way toward profitable acquisition and most prompt and complete success.

The scientific method is not restricted to the work of the distinctively so-called man of science. There is a scientific method in history, in the teaching of languages, in theology or in philosophy, quite as definite as in mathematics, chemistry or physics. There is a scientific method of education and of pedagogy. In all cases it simply means the coordination of the two essentials, knowledge, exact and definite, and sound reasoning, the exact acquaintance of the teacher with the fact to be taught, a distinct recognition and formulation of the principles and laws behind the system of facts and phenomena, and systematization of all contemporary knowledge of the subject in such manner as to permit the presentation of all in concise form, in logical order and in perfect symmetry. There is even a 'scientific method of advancement of science';* as of every other department of human knowledge, even of the spiritual in humanity itself.

The mission of science, therefore, in the broadest sense, is the promotion of all human knowledge and, through the extension of learning and of culture, to give wisdom and to offer opportunity for its exercise.† Its direct product is material advance in the industrial system, providing increasing comfort and leisure for the people and, through this improvement in the lives of men, giving opportunity for the development of the intellect, the affections and the soul. But its highest task, though not a more essential element of progress, is the promotion of the efficiency of all our methods of preparing our youth for the 'future of their lives,' as Paley says, 'to perform justly, skilfully and magnanimously, all the offices, both private and public, of peace and war,' as Milton puts it in his specifications for a 'complete and generous education.' In every department such an education teaches first the facts, then the principles and formulated law, and next the system, and finally all practicable applications and illustrations and, where physical manipulations are involved, as in the laboratories, in the gymnasium, in the military academy or in the applications of science in the industrial arts, the utilization by the practitioner of the sys-

* 'The Scientific Method of Science Advancement,' vice-president's address, American Association for the Advancement of Science, St. Louis meeting, 1878, R. H. Thurston.

† 'The Mission of Science,' vice-president's address, American Association for the Advancement of Science, Philadelphia meeting, 1884, R. H. Thurston.

tem thus established. In abstract learning, the principles and the methods of science, as of philosophy, of history, grammar and of philology, are practically applied in the acquirement of further knowledge by the educator and the investigator, and in securing and in maintaining full possession of that learning by the scholar.*

A 'technical education' must be defined before it can be intelligently discussed, and in this discussion it will be understood that by a technical education is meant one that will most effectively prepare the individual to become competent, after experience has had its ripening effect, 'to perform justly, skilfully and magnanimously, all the offices' appertaining to his vocation. His business in life may be commerce or a profession, trade or transportation, education or theology; in each and all, there is a certain essential foundation of exact knowledge, a certain system of principles assuring stability and characteristic form, and another desirable but less absolutely essential quantity of accessory and incidental information and general education and 'culture,' which is needed to give the man that finish and perfection of fitting for the intercourse of man with man which, while not vocational or professional, is none the less an element of real and highest success.

Proceeding to consider the circumstances which determine the form and extent of the technical education of the citizen, the relation of such education to the whole system of preparation by special training for life's special work, it is first necessary to agree upon a definition of the terms technics, technical, technological. The Greek, from which the terms originally come, in the primary and the broadest sense regards these terms as relating to the arts, both esthetic and industrial, and the technique of the artist, of the musician, of the watchmaker and of the steam-engine builder, in each case, infers special talent or special acts appropriate particularly to the art. Technical education, therefore, is a system of instruction devoted to the development of a knowledge of an art, as, for example, taught in a school of music, of law or medicine, of engineering, of theology, or of any industrial department.

Huxley says: Technical education 'means that sort of education which is specially adapted to the needs of men whose business in life it is to pursue some kind of handicraft'; but this definition is obviously narrow. Technical education is admitted to include engineering, for example, which demands a most extensive and most intense preparation, and involves as large an amount of learning, especially in both pure and applied science, as any other vocation —as much as is demanded in the other schools of the 'learned professions,' once distinctively so called. The technical educations include all the educations which fit the man for 'the sequel of his life,' as a member of a working community. But any business career is chosen as a means to an end, and that end should always be the attainment of a competence to insure comfort in old age, and meantime a comfortable life from youth to age, and the privilege of seizing all opportunities for moral and intellectual growth and for becoming of some use in the world. The business education must, therefore, be accompanied by a general education such as will do most to fit the scholar for his place in the social world, and to take advantage of those opportunities which come to all energetic men and women in a country such as ours.

Fortunately, these requirements do not usually conflict or result in inefficiency of

* 'The Miltonian Teaching.' An address delivered at Pratt Institute, Brooklyn, December 11, 1894.

either branch of work. The opportunities which are opened to the average citizen, or to genius, even, in this country, apart from those of the vocation, may be usually seized by any one having the requisite intelligence, ambition and vigor, if possessed of a good common-school education. If such a person needs more, his common-school training will have set him at the beginning of the path, at least, and will have fitted him to move forward, not as easily and rapidly as if under expert instruction, but, as experience has shown in many cases, so as to attain the object of the ambition of the moment. Fortunately, also, whatever the ultimate aim, the beginnings of education must be those which supply the tools with which to construct a career. The education of the primary, and, in large part, of the secondary, school is a preparation for the whole sequence of life, whatever that sequence may become. The arts of reading, writing and computation underlie all arts and all vocations and professions. The languages are the entrance ways to all the literatures. All persons, whatever their aims, must begin by learning the curriculum of the primary school and must usually go on through that of the secondary school. This is, necessarily, all of the nature of education, as distinguished from technical training. Technical science can not be taught effectively, even where essential to the plans and the future of the individual, until a considerable amount of general knowledge has been acquired and the beginnings, at least, of a liberal education supplied. The beginnings being thus acquired, the ambitious man or woman will find ways of supplementing it; the unambitious will forget what has been already gained.

The place for the beginnings in the teaching of technical science, applied science, science in its applications to business, is evidently at the point where the scholar commences his formal preparation for a business life. Yet it is generally the fact that something should be done in this direction in advance of the actual beginning of the business-school work. There is a certain amount of scientific instruction and something of technical, or applied, science needed by all, whether the future is to be a life of scholarly leisure or one of strenuous endeavor in whatever department of industry. Such sciences are, for example, physics and chemistry. These should be taught in the general course, irrespective of the plans of the scholar for the future of his life. Certain sciences, also—botany, for example—have interest for all and are essential parts of the education of the man whose vocation is to be that of the scholar, as well as of the technical training of the naturalist. These classes of subjects are, or should be, taught as electives when the curriculum becomes easy of enlargement in that manner, after the pressure for necessary primary instruction has been relieved. Thus, through all the earlier stages of the education of the citizen, the curriculum is mainly a fixed one, given form by necessity. Time must be devoted to those studies which the child first and most needs as preliminary to all the later education and life. As these are acquired, opportunity gradually reveals itself for the introduction of special and elective courses to be distributed to the pupils in compliance with the demands of their prospective business lives.

At the beginning of this latter period, the place of technical education and of the teaching of technical science comes into view. As the pupil becomes older and his plans for life more definite, the extent and character of the technical science to be taught him become more obvious and more completely known. But the desirable

course is now to transfer him to the school of his trade, or to that which most nearly supplies its place, where expert instruction in every department may contribute with maximum efficiency to the proposed end. If the 'business' to be pursued is commercial, it would seem that the youth should remain in the academic schools just as long as time and money and natural capacity permit, and then he should take up the work of the business or the commercial school. The sciences taught, meantime, in the academic public schools should evidently usually be those which may fairly be assigned to a general course, as being valuable to all citizens. Specialization implied by technical science should be deferred as long as practicable.

When the vocation or the profession is finally chosen, the pupil will demand preparation for the technical or the professional school and, where the demand is sufficiently large to justify it, special arrangements, if necessary, should be made for meeting its requirements. This may mean the establishment of electives for pupils preparing for the academic college, the law-school or the school of engineering. It may mean some substitution of scientific for the usual educational courses where the latter may be safely thus displaced. Those requirements determine the nature and extent of the scientific and of the technical instruction to be introduced. Where the pupil is to go directly into business and his precise line of work is not settled, or where it is evident that he is of that class, large in this country, liable to pass from one vocation to another, the technical sciences of the curriculum should be, in general, the mathematics and the sciences of physics and, particularly, of chemistry. The constant endeavor of our school boards and committees to crowd the whole pantology of an extensive liberal education into a common-school system can never succeed, and the attempt only embarrasses and renders inefficient the work actually squeezed in. If the school is large enough, as often in the cities, it may be practicable to arrange a system of electives, as is done in the colleges, wherever it appears that a sufficient number may be classed together to compensate the specialist to be employed as teacher. In smaller schools this course is usually impracticable.

Education for a vocation being the leading object of any school, its curriculum properly involves mainly those subjects which contribute especially and directly to, and are essential to, its purpose. General education has no place, as such, here, and the student should clearly understand that his education, in the ordinary sense of the term, should be obtained, and as fully and liberally as practicable, elsewhere, and usually previously to taking up the scholastic apprenticeship. The curriculum of the school should include the essential studies, the sciences and the technical information regarding materials and products, processes and apparatus, which contribute to accurate and efficient work and to economical production. There is always a certain sequence which is entirely logical and which settles all questions of order in taking up the various subjects, and this problem is usually non-existent in the technical school. Thus the mathematics must be taken in a fixed order; the applied science must follow the study of the pure science; and physical and chemical and mechanical work must be given after the mathematics have been more or less completely mastered; for, in the technical school, these sciences are quantitative and involve mathematical processes. In this assignment there is no question of the place of these sciences in the work, as the object to be attained fixes all requirements.

The sciences are all, ultimately and necessarily, taught as applied sciences. There is no time, and no needless expenditure can be made, for the acquisition of abstract knowledge when so much is to be learned which is to be utilized directly. It is thus essential to complete success that the teacher be entirely familiar, as an expert, with the applied science. Experience shows that, in the engineering colleges and schools, thoroughly satisfactory work in the sciences is best insured by the selection, as teachers, of talented and interested scientific men who have given sufficient time to the business for which it is proposed to fit the student to become practically familiar with it and with its applications of his science. The pure sciences are as necessarily also best taught by experts, and this means those who have specialized in the sciences commonly taught in the academic departments of our schools and colleges. In fact, the rule that teaching should not be permitted to amateurs, in any branch, least of all in technical departments, should be made universal.

The curriculum should be as obviously constructed by experts in the business to which the school acts as feeder. Only the expert in the business can say what branches of instruction properly constitute the technical plan of instruction. The determination of the character and extent of the technical work in turn settles the question, What sciences and what general instruction must be supplied as a basis for the technical work? The form of the whole scheme of instruction being thus completely fixed, the details should be assigned to specialists, so far as practicable; each to be familiar as an expert with the work demanded of him.

Every business, even purely commercial, involves some connection with the producing industries, and the commercial man should evidently, in each case, have sufficient familiarity with the industry to be able to buy and sell intelligently and to discuss details involving financial interests with his correspondent.

It would seem that, in the individual case, only the student himself can say precisely what kind and approximately what extent of scientific and technical instruction is required by him. The technical school should be prepared to meet the demands of as large a variety of business interests as practicable, after sufficient experience has been had to permit decision. Probably some knowledge of mathematics, chemistry and physics will prove useful to all. Those intending to go into lines of business connected with the iron and steel industries will demand some instruction in the chemistry of metallurgy; those expecting to deal in products of the machine-making arts will need instruction in applied mechanics and machine-design; those about to enter upon commercial work relating to transportation will need some knowledge of the principles of conduct of shipment and construction of invoices.

The whole case, so far as relates to curriculum building, may be put in a few words, thus: The practitioner in the vocation, professional or other, for which educational apprenticeship is to be provided, should decide what sort and how much technical instruction is needed at entrance into that branch of industry. This schedule of required work should be assigned to experts in each of its divisions, to those who have practical and expert knowledge of the business. The requirements being thus ascertained, the next step is to provide for such studies and such tuition as are needed to prepare the student for beginning the prescribed studies. These being introduced, the next lower stratum of subjects is laid out as introductory to the

preceding, and this process is continued until a curriculum is constructed which, leading up out of the common schools, terminates at its superior limit at that point at which the diploma of the technical school or college becomes a sufficient guarantee of satisfactory preparation to enter the business and to perfect the professional education by the regular practice of the vocation chosen.

The final form and extent of this curriculum must necessarily be determined by experience, and the preliminary outline must be accepted as provisional. The curriculum will be subject to constant change, amplification and improvement in detail, as time and the forward progress of the profession or the business permits or compels, and thus the adjustment of the work to the requirements becomes more and more perfect. Ultimately, the practitioner will find that the institution is doing all that can be fairly asked of it, and the novice entering into business will find himself as well outfitted as is possible in the time and at the expense permissible, and the youth proposing to take up the line of work in view will find his progress out of the common school, into the business school or college, and out of the latter into business, a smooth and continuous and clearly defined movement. Once in business, thus prepared, his success will depend upon his own talent, industry, tact and judgment.

This development of our system of general education is the great work of our day and generation. The wisdom of our statesmen as well as of our educators is to be tested, and is being measured by the promptness and effectiveness with which they adapt their own ideas, and fit the educational system, to the requirements of a modern industrial organization. When they stolidly follow the ways of the ancients, modern life flows past them. Modern educations illustrate the wisdom, the learning, the knowledge and the culture of later centuries. The wonderful gains of the nineteenth century, particularly, are being supplemented by those who have the wisdom of great statesmen, the learning of modern times, the knowledge which science supplies and the culture which comes of a symmetrical education in all the arts, the sciences, the literatures and the philosophies of our own time, so far as it has been permitted to incorporate them into school and college curriculums. The extraordinary work of the German empire had its origin, in fact, with statesmen who, without being themselves familiar with the scientific curriculum, were wise enough to understand its fundamental importance and to know its place in the modern educations and the social system.

The nineteenth century has been called the wonderful century; but the world has, since the commencement of the seventeenth century, at least, been progressing with swift acceleration, and each century has been wonderful and each more wonderful than the last, to the contemporary looker-on. The twentieth century is probably to be more wonderful than the nineteenth, not perhaps in the fact of its seeing the inauguration of a new era in science and the arts, that is a wonder, unique and probably without precedent or later rival; but it will no doubt bring its share of new wonders and of new achievement, opening new realms of nature, utilizing new forces and energies, and availing itself of the old in new and unanticipated and marvelous ways. New elements and new compounds are to be discovered having more remarkable and more useful properties than the old; new methods of manifestation of that protean power which we call energy will be observed and utilized in forwarding the tasks of the engineer and strange and mys-

terious phenomena now puzzling all philosophers, 'natural' or other, will find interpretation and application to good works for the benefit of mankind.

In all this the young men now coming into their opportunities, and their successors of the next generations, will have their part and find their opportunity. The progress of the world is still an acceleration, and the gain and the opportunity acquire magnitude as a rapidly increasing function of the elapsing time. The work of the educator assumes constantly higher value and greater importance and commands more respect and larger distinction. The place of the engineer in the world, lofty as it has been in earlier days, when Archimedes and Leonardo and Watt and Fulton and Morse pointed the way to advancement through the union of the sciences and the arts, and high as it is to-day, when its apprentices are coming forward with the learning of the centuries at their command and the skill of the modern mechanic and inventor and the productive power of all modern machinery at their will; it must grow with the advances of the new industrial world until it shall become one which old-world, old-time, kings may well, and in vain, aspire to hold. The engineer must be the general of the industrial army and in his hands be held the fortunes of nations. Those who to-day witness the foundation or the dedication of a noble structure, appropriated to the work of contributing to the education and the professional training and apprenticeship of the young engineer, are witnesses of an event contributing to the highest welfare of the race. Those so fortunate as to be of the generation entering upon this work with the commencement of the new century have the splendid privilege of taking just as large a part in the growing opportunity of the engineer and his army as their wisdom, talent, ambition and energy may permit them to assume. The man, to-day, who has the wit to recognize opportunity and the skill and ability to take advantage of it may fairly expect to go as far and to rise as high as he may choose—always provided he maintains himself in a condition of mental and moral and physical efficiency. For he must make himself a part of the great machine and keep time with its march, and maintain what I am accustomed to call 'maximum commercial efficiency.'

Perhaps, in this day and generation, nothing can more effectively contribute to the weal of the nation than the institution of efficient means of promotion of the work of the engineer and of his profession. As chief of the industrial army of producers of permanent wealth, his wisdom, his knowledge, his culture and his professional efficiency, as derived by the application of talent and wisdom to the improvement of the apparatus and the methods of production, constitute the primary elements of material progress and, through material gain, of the advancement of the nation and of the race.

The progress of the state in all directions is largely influenced by the statesmanship of the people of the state, through the legislation of the representatives of the people in investing available capital in the cultivation of the applied sciences and the encouragement of the universality, the continuity and the efficiency of the industrial system. A people which is thus made in maximum degree industrious, skilful, fruitful, through the exercise of every talent in the most diversified employments, and capable of thus making the industries in highest degree effective in supplying all the needs of the most enlightened community, attains most promptly and completely the highest position in the scale of civilization.

This end can only be secured by systematic and thorough education, not only in the departments of culture, but also of economic production, including, it should be understood, apprenticeship in the professions and the trades. In no department is this more essential than in engineering, where the sciences of mathematics, of physics and chemistry and of construction find their most important uses, and where a perfected economic system must find its directing minds.

This is also quite as true where the interests of the agricultural classes are involved. This intimate relation of engineering and agriculture comes of two principal requirements. First: The energies and the skill and the talents of the people should be so applied in agriculture that the energy of that industry shall be in minimum proportion given to that form of production which directs its powers toward the provision of articles for necessary but, nevertheless, in an economic sense, wasteful expenditure. The products of agriculture are intended to be destroyed, and the less this production of ephemeral forms of product compels a diversion into the work of providing the needed food-products, the larger the proportion of the producing power of the nation to be directed toward the production of permanent forms of wealth. Secondly: The more efficient this thus increased proportion of the producing power of a people can be made, the larger the accumulation and the more rapid the growth of wealth in the community, in its most permanent forms.

Already agriculture is a branch of mechanical engineering.

The responsibility of the state arises out of its duty to promote the welfare of the people of the state. This duty as respects the common school, the free public school, has long been admitted; it is now coming to be seen that higher education to-day is quite as necessary to the highest interests of the state, and even to its industrial progress, as was secondary education when the latter was inaugurated as a fundamental purpose of statecraft, a primary object of legislation. Of these two divisions of this great task of the state, Germany exhibits the finest example of the higher, the United States, of all nations, the most admirable example of the lower. But the higher, and especially the technical, education of all competent to profit by it effectively, is now recognized as an essential which only the state can supply fully, continuously and without distinction of class of citizen.

The state, therefore, inaugurated this work with the enactment by the national legislature of the Land Grant Bill of Senator Morrill, although at the time the nation was engaged in a struggle for life and the civil war was in its most uncertain stage. The several states, following this initiative of the general government, have since assumed their duty, usually in a liberal and enterprising and patriotic spirit, sometimes with apparent reluctance and occasionally evading it largely. In this matter the western states have been usually more statesmanlike than the eastern and fine buildings and noble institutions of learning have marked their progress. In the older states there are larger numbers of colleges already established, often long established and firmly founded by private grants and individual generosity, and there has been less apparent necessity of action by the state, although the essential difference between higher education for the average citizen and that desired by the man of leisure or a member of a so-called 'learned' profession is coming to be seen

and provided for even amongst the most conservative of the older colleges.

In some states the work of the state is carried on by private contributions, in large part, directed, nevertheless, toward the education of the people for life. It is, however, well understood that the work is essential to the progress of the country, and that, on the whole, it is not safe or wise to leave it to the sporadic and fitful care of private benevolence; the duties of the state should never be entrusted to enterprises which are of necessity usually mendicant and unequal to their work as are the colleges generally. The latter are always poor and always more or less inefficient from that cause and they are always necessarily mendicant, receiving their accessions of income irregularly and commonly least freely when most in need. This work must ultimately be mainly carried on by the state to insure thorough efficiency and most rapid advancement of the industries and of the people. There will always be ample opportunity for private means to flow into this form of investment for special purposes; but the state must make it certain that the forward movement of civilization and the advancement of the nation is not permitted to halt because of any lack of provision for education of the coming captains of industry or any defect in efficiency of the means thereto. Every man of genius, whatever his circumstances, will be assured of the privilege of gaining that essential training and learning which only can make his genius of value to the world. It is the state which must provide these 'freaks of nature,' as Huxley called them, these Watts and Faradays and Davys, each genius, according to the great man of science, 'cheap at an hundred thousand pounds.' That nation will go furthest and fare best which produces and utilizes most fully the largest number of these 'freaks of nature.' Our country has, perhaps, produced most freely and utilized most fully; but the time has come when even the man of genius, whether in science or in industry, must, to make his talent effective, know what the world has acquired of learning, and must be trained usefully and effectively to apply that learning by means of the most perfect of all known apparatus and methods. That nation which fails thus to utilize its men of ability will inevitably fall behind, and its people taste of the bitter bread of poverty.

That state which most and best avails itself of the opportunity to establish institutions of higher learning for the promotion, particularly, of the industries, through education for their leading positions of those men of ability, who will invariably seek their opportunities, will find its investment a handsomely paying one. One such man recently saved to the state of New York a million dollars by a single scientific investigation, and every young man leaving the engineering school has his value doubled at the start, and often multiplied many times later, by the training thus provided by the state. The investment is one which pays the state better than any possible purely commercial one can, and the future is far more advantaged than the present and the public at large is profited many-fold by the ability, natural genius trained by scientific method, which is thus gained for its industrial system.

It is not sufficient, however, that the education offered shall be the best possible of its kind; it is essential for its full utilization, that it shall be given by those who are experts, each in his own branch, and, still further, that each of these experts shall be in constant and intimate touch with all the contemporary, and especially the local, industries of the state. Highest

efficiency can not be attained and most prosperous conditions reached by the state unless all the industries are closely and helpfully knit together, and unless every individual in each promotes to the best of his ability the work of each and every other. The state college or university has for its particular opportunity and its especial duty this promotion of the mutual helpfulness of the various departments of industry. Its representation at conventions, its provision of valuable information and its keeping the leaders in the industries well informed of the progress of science and of the arts in directions having interest and importance to them; its scientific researches and attempted discoveries, or its revelations of facts and phenomena having importance in the industries; its finding of the right men for special and important places in which peculiar talent and special training are needed; perhaps more than all, its introduction of new arts and industries and new methods of utilization of natural resources: each and all may advance the best interests of the state inconceivably, and all costs become insignificant in comparison with the benefits derived. This has been true in the past; it will be still more impressively true in the future. It is only the state, however, which can properly carry on this great work and do full justice to the people and to the opportunity.

As between the state and the state college, the obligation is mutual; the college, as the creature of the state, owes to the people composing the state its highest and best work, and always primarily in the interests of the mass of the people and the fundamental industries of the state. The state, on the other hand, owes a duty to the college and, through it, to the people, again: this is the maintenance of the college constantly at the highest possible state of efficiency and fruitfulness by providing it with men and material and suitable accommodations of every sort in such manner that no one member of the staff shall find his usefulness decreased by reason of deficient space, equipment or opportunity to do good work for the state and for the learner.

In meeting these mutual obligations, experience would seem to indicate that it is the state rather than the college which fails of either interest, ambition, earnestness or conscientious compliance with duty. It is oftenest the state which fails to see the opportunity to promote the best interests of the people and to take advantage of that opportunity.

In the hundred or more engineering schools of the United States are about fifteen thousand students, of whom about fifteen hundred pass out into business each year. The growth of these schools has been five hundred per cent. in the last generation, although comparatively few of the splendid private contributions to education of these years have been placed here, where most needed. A few large schools send out the greater part of these young engineers; one third sending out half and more.

A list of one thousand has been prepared for me, tabulated. The average period since 'graduation' is about seven years. Of these, so far as reported, one third are holding positions of independent responsibility; one eighth are managers and superintendents of works; ten per cent. are teaching in the professional schools, and twice or thrice as many are wanted. Ten per cent. are designing engineers, planning the machinery of the workshops, the manufacturing establishments, the railroads, and the fleets of the country. Several are editors; one fourth are manufacturers; many are presidents

and vice-presidents of corporations; others are treasurers, and the balance are distributed throughout the whole system of industries of the country. One half of these men are not above an average of 25 or 28 years of age, and ninety-five per cent. are not above 35 or 37. Practically all retain their connection with their profession. They commonly realize and fully appreciate their advantages, educationally.

One writes, for example, 'The great value of the training given me and especially by the college is brought home to me forcibly many times every day and I prize that training more than all the wealth of the land.'

The severe pruning out of men unsuited to the profession has given these professional schools of engineering the reputation of producing the best-trained of all professional men.

More perhaps than in any other profession is it true that the practitioner, to be successful—which means to be in highest degree useful to the state—must possess a peculiar mental and intellectual make-up. He must unite—at least this is coming to be true very generally if not universally—he must unite that strength of character which every leader must possess, with good sense, such as all men commanding the respect of their neighbors must exhibit, with integrity such as no man can advance without, with thorough professional education and training such as is always essential to professional success. It is further true that the intellectual training of the engineer, for example, furnishes as large opportunity and as great capacity for purely intellectual enjoyment as can possibly any ordinary purely 'cultural' education. Nevertheless, the preparation of the engineer for greatest fulness of life demands cultural study and an extent of learning far broader and deeper than the solely professional. He, like all other men, must for highest results make himself a liberally educated man and must attain wisdom as well as culture, learning as well as technical knowledge, if he is to meet men on a common and lofty ground. It is not enough that he shall make of himself a most efficient machine; he must make of himself a gentleman and a scholar as well as a professional.

The outlook for the young man going out into business of whatever sort from a course of study which has comprehended the elements of a good, sound, English education, college courses which have given him some familiarity with the contemporary literatures and access to the languages in which the thoughts of the masters in his field are immortalized and the practice of his art is exemplified, and from a technical training, a professional apprenticeship, which has built up for him foundations, firm and stable, upon which to raise the structure of his later professional career: the outlook for such a man, if himself well fitted by talent, character and experience to profit by his advantages and opportunities, is now more promising than ever before in the history of the world. The tremendous aggregations of industrial enterprises now coming into form can only be handled by men of more than ordinary capacity, wisdom and experience and only the complete union of the learning of the schools, the judgment gained by experience and the intimate knowledge of the business acquired by the practice of the profession or the vocation, all conspiring with perfect union of the science with the art, will hereafter give highest efficiency in positions of responsibility. The army of industry is now organized and must be officered. Its grades are coming to be as distinctly recognized and established as those of the military or the naval organization, and the

kind of man needed for each grade is as distinctly defined. Every competent man will gravitate to his place; for the head of the army and the chiefs of staff are eagerly looking for that rare and precious character for each position as vacated by the falling out of the incumbent of the moment by retirement or death.

Of the calls which I have received for such men from the 'captains of industry,' 45 per cent. are for positions worth $750 to $1,000, 15 per cent. at $1,200, 20 per cent. at $1,500, 15 per cent. at $2,000, 5 per cent. at $2,500, and in many cases from two to ten men are sought. The needs are greatest in the highest positions and where men capable of carrying large responsibility and having exceptional executive capacity find their place. One man who did not take his diploma for some years after a business call had withdrawn him from his earlier studies is now a vice-president of one of the largest corporations in the United States; another, only about ten years out of college, has become the president of several important corporations aggregating several millions in capital and as a whole extraordinarily profitable, mainly through his ability, good judgment and business efficiency.

One of the best gauges of the value of these men when well suited to their professions is found in the fact that, when these alumni of the engineering college are asked if they desire to change their present positions, they almost invariably reply that they are well satisfied. Asked at what salary a change would be considered, ten per cent. of these giving definite figures proposed $1,000, 30 per cent. $1,500, 30 per cent. $2,000, 10 per cent. $2,500, and 5 per cent. in each grade $4,000, $5,000 and $6,000. The ablest men in highest positions usually declined to consider a change of employers or of employment.

The young engineer, just from college, if he has profited by his opportunities usually gets on slowly at first and very rapidly later. The man who refused $1,500 a year to accept fifty cents a day, where his opportunities were greater for learning his business, now receives—six years out of college—$3,500; the usual figures are $60 to $75 a month when employed rather than taught in the great manufacturing organizations. Salaries a little later range from $1,000 to $3,000 and sometimes $5,000 and $6,000. The average asked by men willing to change their fields of work as reported a year or two ago was about $2,000 for men seven years out of college. One young man dropped out of college to secure an opportunity to become familiar with an important industry, the chance coming unexpectedly. He returned to take his degree, three or four years later, with a contract for four years, at $6,500 a year, in his pocket.

Many become inventors in their chosen fields and accumulate fortunes rapidly. Others enter great enterprises and build up the cotton manufactures of the south; direct the great departments of the electrical industries; revolutionize the methods of production of pig iron; produce a tool-steel capable of multiplying the work of machine tools; invent a steam-engine governor and take in royalties of thousands a month; systematize a gas industry, gaining a fortune while financially benefiting the stockholders and the gas-consuming public; multiply the rate of transmission of intelligence across the ocean, beneath or above its surface; utilize the electrical energies in light and power transmission by new methods; organize new systems and new industrial establishments. All who

thus contribute to the welfare of the people are very sure to secure a handsome commission and scores of these men of the new generation are thus helping others while helping themselves. The conduct of the industries of the country is constantly more and more falling into the hands of the systematically trained and technically learned man.

Young men, such as our best professional schools of engineering are now turning out, are greatly needed and the need is recognized by employers. The demand has been for some years past greater than the supply. A generation ago it was next to impossible to induce the average manager of an industrial establishment to admit the college man within his doors. To-day the same class of men is sought by all, and the larger and the more important the interests involved, the more anxious are the officers of the organization to find men trained in the professional school, combining science with practical knowledge, and prepared to face and to solve the tremendous problems now constantly arising. I have a deep file of letters calling for such men; there is practically none unemployed, unless on the sick-list. All the professional engineering schools are thus situated. Turning out a thousand or more annually, the whole output is absorbed by the great industries and immediately upon leaving the doors of the college. If suited to the profession, success is assured; otherwise, failure is just as certain.

The prizes to be won, like those in all other professions, are large; there is always room at the top; the earnings at first are usually small in cash, large in valuable experience; opportunities come in increasing number if the man is the right man for the higher place; more men are needed than can be found to take the higher positions of responsibility and of commensurate compensation. The wise young professional seeks opportunity for profitable experience without much regard to compensation. I have known a man to refuse a good salary and to accept fifty cents a day, where he saw an opportunity to secure practical experience and training such as, in his estimation, was what he most needed. His spirit was that of Agassiz, who, when asked why he refused an important and lucrative business position, is said to have replied: 'I can not afford to give my time to money-making.' Both had their rewards, each in his own way, in that form of professional success which was the highest ambition of each. Many young college men are to-day working for the great railroad companies, for the electrical companies and for industrial enterprises of all kinds, accepting insignificant pecuniary reward for the time, in order that, by securing that special experience and expert knowledge needed to supplement their special education, they may prepare themselves for positions of honor, of responsibility and of financial value. Here 'the last shall be first.'

It is of little consequence what line of work the young man enters, provided it be that for which he is individually well fitted by nature and training. In mechanical and electrical engineering, in shipbuilding and in the railway system, in mining or in public works, great opportunities are all the time, and more and more frequently, offering. It matters little what line the man selects, provided he is naturally fitted to do the work, by talent and by inclination, and that he acquires promptly the needed professional training and a later experience. If able and reliable and loyal to his employers, he is far more likely to be promoted faster than is desirable than to remain unrecognized in any important organization. His early years should be devoted to securing pro-

fessional knowledge and practical experience, efficiency in his business and ability to deal with other men. Opportunity, responsibility and financial returns will come later, once he reaches the age at which older men holding such positions begin to drop out. If suited to the work he will find his place.

Meantime, the work of the world is falling into the hands of these able, expert, experienced and efficient men of the new generation in rapidly increasing proportion, and the professionally trained engineer now finds himself wanted wherever learning, ability and experience are essential to the success of a great enterprise.

In this great work the student for whom all these sacrifices are made has his part, and his duty is quite as imperative in the utilization of these opportunities as is that of the state to provide them. His first privilege and duty is that of playing his part conscientiously and well. If unable to do the work well that is set before him he should retire to make place for a more competent candidate for opportunity; if found lacking in conscientiousness, he should be retired.

Stradivarius, whose violins to-day will fetch large sums, though they cost but little two centuries ago, in answer to a charge that he worked only for pelf, replied:

"Who draws a line and satisfies his soul,
Making it crooked where it should be straight?
An idiot with an oyster shell may draw
His lines along the sand, all wavering,
Fixing no point or pathway to a point,
An idiot one remove may choose his line,
Straggle and be content; but, God be praised,
Antonio Stradivari has an eye
That winces at false work and loves the true,
With hand and arm that play upon the tool,
As willingly as any singing bird
Sets him to sing his morning roundelay,
Because he likes to sing and likes the song."

The spirit of Stradivarius is that which underlies all success, and not only should the protégé of the state illustrate this spirit as justifying his adoption by the state; but he should understand that the interest and pride and ambition of Stradivarius are essentials of his own later advancement. Thoroughness in college work is no less essential and fundamental an element of success with the individual than is the success of the outgoing army of alumni vital to the progress of the country and the growth of the state in all that makes success for the people, or that makes life worth living for the dweller in their midst. Given this spirit of wholesome and cheerful ambition and the atmosphere which it engenders, and the world will be the better and the brighter each day.

Our own progress as a nation depends upon the wisdom and foresight, the patriotism and courage and persistence of our own educators and statesmen and industrial leaders. With wise statesmanship, our own nation may become the leader of the world and our country may always move onward in the van of modern progress. At the moment, what is most needed is the awakening of our legislative and executive officials to the duties and the opportunities of the times. It is the fossilized educator and the ignorant and unpatriotic politician, and the demagogue who aspires to lead 'labor,' and the educated man with his head in the clouds, who are the most serious obstacles to the progress of education, and to that of the nation toward higher and better things. These classes being either enlightened and purified, or extinguished, we may trust the American people to take full advantage of their opportunities and to hold a foremost place in the peaceful rivalry of the nations.

ROBERT H. THURSTON.

SIBLEY COLLEGE,
CORNELL UNIVERSITY.

ROYAL SOCIETY CONVERSAZIONE.*

The first of the two Royal Society *conversaziones* has been held at the society's rooms in Burlington House. There was, as usual, a large attendance, the visitors being received by the president, Sir William Huggins.

The exhibits seemed to be more numerous than the average, and, on the whole, each had a wider range than last year. Exhibits in the departments of physics and chemistry predominated, electricity and its applications being prominent. Naturally, special interest was manifested in the new coherer as applied to wireless telegraphy, shown by Sir Oliver Lodge and Dr. Alexander Muirhead. The coherer consists of a steel wheel which rotates so that its edge touches a pool of mercury through a film of oil, the decoherence being automatic. A fraction of a volt is used in the detecting circuit, which works a siphon recorder as the receiving instrument. The sending post of the station was also shown. It ought to be noted that some years ago, at a Royal Society *soirée*, Sir Oliver Lodge exhibited an arrangement for wireless telegraphy, of which this may be regarded as the parent stage. Sir Oliver Lodge is devoting himself rather to the perfection of his arrangement than to the attainment for the present of long distances. Another exhibit which naturally attracted much attention was that by Sir William Crookes, illustrative of the properties of the emanations of radium. There were autoradiographs, photographs of radium emanations, luminous effects of radium emanations, and an ingenious little instrument which Sir William Crookes calls a spinthariscope, intended as a convenient contrivance to show the scintillations of a piece of radium nitrate. A solution of radium on a small plate formed a permanent lamp, which might really be of practical use.

* From the London *Times*.

Included among other exhibits of an electrical character may be mentioned the Rev. F. J. Jervis-Smith's high-pressure spark-gap, consisting of a thick glass globe furnished with two platinum-faced balls, adjustable for distance, used in connection with an inductor of the Tesla type, and also in connection with a radiator of Hertzian waves. Mr. A. Williams showed some brilliant experiments to illustrate a method, by means of a shunt, of controlling and regulating spark discharges, so as to make them more regular and more under control for therapeutic and wireless telegraphy purposes.

Dr. W. Ramsden's experiments, to demonstrate the presence and spontaneous formation of solid membranes upon the free surfaces of certain solutions, were striking, and some of the results, including micro-photographs and microscopic specimens, were very beautiful. Mr. Joseph Goold's diagrams, illustrating the order and origin of the musical scales, showing that the system of sounds commonly employed in written music is dual throughout, were remarkable. Mr. A. E. Tutton exhibited an elaborate arrangement which he calls an elasmometer, for the determination of the elasticity of solid substances, particularly crystals, which can not be obtained in very large pieces. Mr. W. Watson's light mirrors suitable for galvanometers are made of fused silica, the reflecting surface consisting of a film of platinum. An experiment by Mr. O. W. Richardson illustrated the conductivity imparted to a vacuum by hot carbon. Dr. Common exhibited a collimating gunsight for use by day and night, consisting of a lens mounted in a tube fixed at the top or side of the gun, with a fiducial mark at its focus, the mark being a black spot for day work or a small luminous red spot for night work. Dr. Common also showed an optical sight

for guns and rifles, and a spherometer of great delicacy. The Rev. John Bacon's aerial photographs were extremely interesting. They were obtained recently from balloons in unique circumstances. Mr. T. Matthews showed some incandescent oil-burners which have been designed by him, primarily for use in the Trinity House lighthouse service. The arrangement, like that of most of the other exhibits, is too elaborate to be understood by mere verbal description; but it may be stated that the intensity of a single mantle burner for flashing lights is 1,100 candles, and the consumption of oil one pint per hour, while the intensity of a triple mantle-burner, for fixed and occulting lights, is 2,700 candles, and the consumption of oil three pints per hour.

From the Solar Physics Observatory, South Kensington, were photographs illustrating a comparison of the arc spectra of various samples of dust, showing what chemical elements are represented in the samples. There were also some very interesting and convincing curves illustrating the long-period solar and meteorological (rainfall) variations of about thirty-five years. As might have been expected, a number of exhibits were connected with the recent destructive volcanic phenomena in the West Indies, which were investigated by a commission sent out by the Royal Society. There were a number of photographs illustrating the late eruptions in St. Vincent and Martinique and also specimens of the volcanic dusts, ashes and other *ejecta* of the West Indian volcanoes. It need hardly be said that Mr. Arthur J. Evan's exhibit illustrative of the excavations at Knossos, in Crete, deservedly attracted considerable attention. The exhibit consisted of a general plan of the Palace.

There were a considerable number of biological exhibits, which can only be briefly alluded to. Deserving of careful study are the results of the experiments shown by Miss E. R. Saunders illustrative of what she calls structural atavism, resulting from cross-breeding in plants. Dr. A. Macfadyen and Mr. S. Rowland, of the Jenner Institute of Preventive Medicine, illustrated their methods of disintegrating cells and micro-organisms and of obtaining their intracellular constituents. Dr. Alan B. Green had an exhibit illustrating the method of preparation of chloroformed calf lymph, from the government lymph laboratories. Dr. G. H. Fowler showed specimens of a remarkable radiolarian, differing in structure from all other forms hitherto described, and Dr. H. Gadow a very beautiful illustration of the development of the color pattern in Mexican species of lizards and a convincing illustration of the influence of environment. The five specimens of sea snakes that swarm round the coasts of India and in other tropical seas, exhibited by Dr. Leonard Rogers, their poison being more powerful than that of any other snakes, though interesting in their way, can hardly be said to have been attractive. Miss Dorothy Bate showed the remains of pygmy elephant and pygmy hippopotamus, obtained from caves in Cyprus.

The exhibition by means of the lantern of Sir Benjamin Baker's magnificent slides illustrative of the Nile Dam works, it need hardly be said, met with universal admiration. Dr. Cantellani's specimen of Trypanosoma, found in sleeping-sickness patients in Uganda, should be mentioned. There were many other exhibits in the rather crowded rooms, all of them illustrative of important scientific work.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF BIOLOGY.

A REGULAR monthly meeting was held at the American Museum of Natural History

on May 11, Professor Bashford Dean presiding. Papers were presented by Professor H. F. Osborn, Professor E. L. Thorndike and Mr. C. T. Brues.

Professor Osborn's paper, 'On Recent Models and Restorations of a Number of Extinct Animals, with a Discussion of their Probable Habits and Mode of Life,' was based upon models and restorations from the Department of Vertebrate Paleontology of the American Museum of Natural History, prepared by Charles Knight under the direction of the speaker, with the assistance of other members of the department. Numerous models and drawings were exhibited and described. Of special interest were the following: *Elephas imperiales* (Imperial mammoth); *Trilophodon productus* (Miocene mastodon); an *Ichthyosaurus* and young; several Pleistocene rhinoceroses; and *Diplodocus* (a bird-catching dinosaur).

Professor E. L. Thorndike, on 'Natural Selection and Fertility in Man,' reported a study of the size of families of college graduates during the nineteenth century, and of the descendants of a New England family during the eighteenth and nineteenth centuries. The average number of children in the latter case rose gradually to an acme in the generation born about 1720, and then fell steadily, the figures for eight generations being 5.3, 6.3, 7.7, 10.0, 7.2, 5.5, 4.4, 3.8. This rise is inconsistent with the common hypothesis that social custom is the cause of change in the productivity of races. So also is the form of the surface of frequency of family size in the later decades of the nineteenth century (see *Popular Science Monthly*, May, 1903, p. 68). A real decrease in natural fertility would account perfectly for the statistical appearances found; and, if we judge only by them, is the most likely hypothesis.

Mr. Brues presented a preliminary account of the internal factors of regeneration and reversal of asymmetry in the crustacean *Alpheus*. Przibram and Wilson have recently shown that when the larger of the asymmetrical chelæ of these animals is amputated, the smaller one on the opposite side develops into a claw of the large type, while a small one regenerates on the stump of the large one. If the nerve of the small claw be severed at the time of removing the large one, reversal does not take place, or only incompletely. Histological examination of animals in which such changes are taking place indicates that the regeneration and remodeling are influenced by the nervous system, due possibly to increased nutrition in the ganglion which supplies the small chela. As the nervous system shows no morphological asymmetry corresponding to that of the claws, it probably acts only in a passive way in determining the type of the claw, although it evidently gives the stimuli for the more minute changes which take place in the remodeling of a small chela to form one of the large type.

M. A. Bigelow,
Secretary.

CLEMSON COLLEGE SCIENCE CLUB.

At the meeting of March 20, Dr. J. H. James read a paper on 'Some Facts and Theories in Regard to Dyestuffs.' The history of the processes of dyeing before the latter half of the nineteenth century was briefly told, but the achievements in the preparation of synthetic coloring matters were fully treated. The paper discussed the main points in the synthesis of alizarin and indigo, and the theories relative to the relation between the chemical composition of synthetic dyestuffs and their coloring power. Professor S. W. Reaves presented 'An Historical Note on the Invention of Logarithms,' at the close of which he illustrated the purpose and usefulness of logarithms by well chosen examples. Professor W. M. Riggs exhibited the Clark automatic switch board, the utility of which he demonstrated.

At the meeting of April 17, Professor J. H. M. Beaty presented a paper on 'Some of the More Important Characteristics of the Cotton Fiber.' Professor Beaty spoke of the difficulties encountered in the manipulation of the cotton fiber, and discussed its behavior when treated with dilute caustic potash before bleaching, and the apparent changes when brought in contact with a concentrated solu-

tion of caustic potash for mercerization. The lecture was illustrated with lantern slides as well as the fibers, which were also projected upon the screen.

The annual address before the club and student body was delivered on April 30, by Dr. Henry Louis Smith, of Davidson College, who selected for his subject 'The Intellectual Value of Scientific Training.' In further celebration of the date of organization, a banquet was given by the active members.

At the meeting of May 15, Professor P. T. Brodie gave a paper on 'The Development and Design of the Modern Bridge Truss.' Professor Brodie traced the evolution of the simple truss from the king-post to the types exemplified in the great bridges of to-day. The general criteria for maximum shear and moment from a given system of locomotive and train loading were deduced, and their applications of stress determination as used in the actual design of a Pratt railway bridge were clearly demonstrated. The lecture was illustrated with lantern slides and blackboard drawings.

The following officers have been elected for next year:

President—Chas. E. Chambliss.
Vice-President—R. N. Brackett.
Secretary-Treasurer—F. S. Shiver.

CHAS. E. CHAMBLISS,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE PROPOSED BIOLOGICAL STATION AT THE TORTUGAS.

TO THE EDITOR OF SCIENCE: I have been much interested in the discussion of the question as to the best place for the location of a tropical marine laboratory for research, which has been going on in the columns of SCIENCE for the past few weeks, and since we are all agreed on the desirability of such a station it is very proper that the problems involved in its establishment should receive careful consideration. I may be pardoned, therefore, if I say a few words in support of Dr. Duerden's contention that Jamaica is the best available place, for although I have never visited the Tortugas, I have spent two weeks in Bermuda, and have made three trips to Jamaica, for zoological purposes.

My experience leads me to believe that a marine laboratory, and especially one in the tropics, ought to be situated where the advantages of civilization are reasonably accessible, and particularly the important one of competent medical assistance in case of accident or disease. We never plan to be sick or to meet with accidents, but we ought not to locate a permanent station where there is no possibility of help when it is most needed. The other advantages of a civilized community, such as good mail and telegraph facilities, good markets and satisfactory means of reaching other places, are of real importance and should not be ignored.

For these reasons the Tortugas seem to me seriously handicapped and even if regular service between them and Key West were maintained, I can not believe that in point of either time or expense, they would be as accessible to students from the central west as are the Bermudas. As between the latter and Jamaica, there can be little question that the larger island has the advantage, not only for the reasons so well presented by Dr. Duerden, but also because of the greater variety and abundance of its marine fauna. Good as is the collecting in Bermuda, it is better in Jamaica, partly because the latter island offers a greater variety of shores and bottoms. While Bermuda is undoubtedly more accessible, and can be reached at less expense, from New York, from all parts of the south and southwest Jamaica can be almost as easily and cheaply reached by means of the excellent steamers from Baltimore. Living expenses in Jamaica are very low, though perhaps not much lower than in Bermuda.

The one claim that is made for the Tortugas is the remarkable abundance and accessibility of the marine life, in both deep and shallow water. While this may be a point in which that station excels Jamaica, I am sure any one who has collected on the reefs of the latter will find it hard to believe that such is the case. But even were it so,

the superior facilities for land and fresh-water work offered by Jamaica are a far more than compensating advantage.

Finally, I should like to emphasize the very great advantage which would come to the laboratory from being located in the midst of such a hospitable community as is to be found in Jamaica. This is a point upon which Dr. Duerden would naturally not care to enlarge, as he was himself for four years a leader in extending courtesies and favors to visiting scientists. The government officials and the officials of the fruit company, which virtually controls communication with the United States, are simply unwearying in their efforts to put the visiting scientist under lasting obligations, and if Jamaica were selected as the site of the proposed laboratory, there is nothing the people there would not do to make the establishment a success, and to convince all comers that there is no place like Jamaica.

Hubert Lyman Clark.

Olivet College,
June, 1903.

SHORTER ARTICLES.

ON THE STRUCTURE OF THE PLESIOSAURIAN SKULL.

An excellent example of a plesiosaurian skull, recently kindly entrusted to me for study by the authorities of the National Museum, confirms so well the rather remarkable determinations of the frontal elements recently published by me, that I desire to make a brief mention of the matter in Science, in anticipation of a more complete description, which may be delayed a year or two. The specimen is from the Eagle Ford Shales, from the vicinity of Austin, Texas, and is, I have little or no doubt, both generically and specifically identical with the type of *Brachauchenius lucasi*, recently described by me from the Cretaceous of Kansas. The specimen lies with its dorsal surface exposed, beautifully supplementing the type specimen of the species now exhibited in the National Museum.

I have no longer any doubt that the so-called frontal bone in all plesiosaurs is in reality a rostral prolongation of the parietal bone, extending forward to meet the premaxilla, and completely excluding the frontals from union in the median line. There is no supraorbital bone, and the so-called postorbital is really the postfrontal, or postfronto-orbital. The nasal has never yet been certainly found as a distinct ossification, but the lachrymal exists as a distinct bone, though often fused with the maxilla.

The study of this specimen confirms my belief that the genus is closely related to *Pliosaurus* of Europe, from which it is distinguished by the entire absence of double-headed cervical ribs. I am, furthermore, convinced that the genus belongs to a family distinct from the true plesiosaurs, and I believe that this family is the Pliosauridæ, hitherto rejected by most students of the order. Whether all the characters given below will apply to the European forms I do not know, since the palatines are *thought* to be separated in *Pliosaurus*, and others may occur in true plesiosaurians. I would, however, define the family as follows:

Pliosauridæ: Skull depressed; no parietal crest; palatines broadly contiguous in the middle line; pterygoids with a prominent ridge and abutting mandibular process. Neck short; cervical ribs single or double headed; all vertebræ without infracentral vascular foramina.

S. W. Williston.

THE REACTIONS OF PARAMŒCIA AND OTHER PROTOZOA TO CHEMICAL AND ELECTRICAL STIMULI.

The recent work of Mathews * on the nature of the chemical stimulation of the motor nerve, and that of R. S. Lillie † on the reaction of nuclear and cytoplasmic structures to the electric current, have greatly strengthened the theory that protoplasm, at least in some of its forms, consists of a colloidal solution whose particles may be either positively or negatively charged.

The present paper is a brief preliminary account of some experiments on the reactions of *Paramœcia* and other protozoa to chemical and electrical stimuli, and the visible changes

*Mathews, Science, XV., 1902, p. 492, and XVII., 1903, p. 729.

† Lillie, *American Journal of Physiology*, VIII., 1903, p. 273.

produced in the protoplasm by these means.

The results of the experiments seem to show that in these forms, also, the colloidal particles in the protoplasm carry a definite electrical charge, and to demonstrate further that the sign of the charge depends directly on certain external conditions surrounding the organism.

The results of a series of experiments carried on last year on the effect of variations in temperature on unicellular animals suggested a very close similarity between the reaction of these organisms to variations in the temperature, and the effects of the same temperature variations on artificial colloidal solutions as observed by Hardy and others. This fact, and especially the conclusions of Dr. Mathews on the chemical stimulation of the nerve, led me to test the effects on the protoplasm of *Paramœcia,* and other protozoa of a series of solutions of acids, bases and salts, with the following results: All the acids and the solutions of all the salts with a predominant positive charge that were used in the experiments, had a common effect on the *Paramœcia,* viz., a coagulation of the protoplasm, and the formation of simple resting cells, similar to those formed by low temperatures. Likewise all bases, and the solutions of all salts with a predominant negative charge, had one and the same effect, viz., a liquefaction of the protoplasm and a stimulation of the metabolic activity of the organism, similar to the effects of a slight increase in temperature. The following solutions carrying a predominant positive charge were used: $m/800$ HCl, H_2SO_4 and HNO_3; $m/160$, $mg\ Cl_2$, $CaCl_2$, $BaCl_2$ and $Ca(NO_3)_2$; and the following with a predominant negative charge, $m/800$ $NaOH$, KOH and $Ba(OH)_2$; $m/160$ Na_2SO_4, $(NH_4)_2C_2O_4$, Na_2HPO_4 and $Na_3C_6H_5O_7$. The rapidity and extent of the coagulation or liquefaction vary directly with the valence of the salt. Thus the phosphate and citrate are effective in greater dilutions than the sulphate. The exact figures will be given in the complete paper.

The *Paramœcia* used in the above experiments were taken from cultures which were slightly alkaline in reaction. It was found that if just enough hydrochloric acid was added to the culture to give it a trace of free acid, the reaction of the *Paramœcia* to the salt solutions was nearly reversed. The protoplasm of *Paramœcia* from such an acid culture is either not affected by the solutions of salts with a predominant positive charge, or in some cases is slightly liquefied. But such an acid-modified protoplasm is coagulated in most instances by the solutions of salts with a predominant negative charge. These results agree almost exactly with Hardy's on the acid and alkaline modified colloidal solutions of egg albumen, and lead to the conclusion that in the living protoplasm of *Paramœcium,* as well as in artificial colloidal solutions, the charge which the colloidal particles carry depends directly on the reaction of the surrounding medium.

The chemotaxis of *Paramœcia* from alkaline and acid cultures was tested, and it was found that this response, also, may be reversed by changing the reaction of the culture. For example, *Paramœcia* from an alkaline culture are negative, while *Paramœcia* from an acid culture are positive to weak hydrochloric acid. It thus seems probable that the sense of the chemotropic response of *Paramœcium* depends upon the sign of the charge carried by the protoplasmic particles.

If it is true that the charge on the colloidal particles in the protoplasm of *Paramœcium* may be reversed by changing the reaction of the surrounding medium, then *Paramœcia* in an acid solution ought to show a different response to the electric current from *Paramœcia* in an alkaline solution, and experiments showed this to be the case. *Paramœcia* in an alkaline culture are strongly negative to the electric current. If, however, a few cubic centimeters of the culture containing the *Paramœcia* be isolated in a small dish, and weak hydrochloric acid added, drop by drop, a point is soon reached at which some of the *Paramœcia* begin to swim toward the anode and this reaction may be increased by a further addition of acid until half of the *Paramœcia* show a decided positive response.

Likewise *Paramœcia* which in an acid culture are positive to the electric current may be made to reverse their reaction by gradually neutralizing the acid with sodium hydrate. Lillie has observed a similar relation between the response to the electric current and the condition of the protoplasm, whether acid or alkaline, in his experiments upon nuclear and cytoplasmic structures cited above. He showed that nuclear structures, which contain a large amount of nucleic acid, move toward the anode, while cells very rich in cytoplasm, which is basic in reaction, move in an opposite direction when exposed to the electric current.

It thus appears, from the experiments on *Paramœcia* here outlined, that the conclusions suggested by the work of Mathews and of Lillie are capable of a wider application than has heretofore been given them, and that a definite relation exists between the sign of the charge carried by the protoplasmic particles and certain external conditions surrounding the organism. It also follows from the experiments that by varying these external conditions, we are able not only to reverse the charge carried by the protoplasmic particles, but also the response of *Paramœcium* to certain forms of chemical and electrical stimuli.

A. W. Greeley.

Zoological Laboratory,
Washington University, St. Louis, Mo.,
May 19, 1903.

NOTES ON ENTOMOLOGY.

Mr. W. L. Tower has given an account of the origin and development of the wings of coleoptera.* It is illustrated by seven plates and figures in text. The studies were based on species of various families (mostly phytophagous). He believes that the elytra are homologous to the fore-wings of other insects, the only logical position. As to the origin of the wings his studies lead him to accept Verson's view that the wings are derived from the rudiments of the meso- and metathoracic spiracles. Verson's theory was published in 1890, and based on his study of the silk-worm (*Bombyx mori*). Very substantial objections are advanced by Tower to the two other theories of wing-origin, that of the tracheal-gill origin and that as prolongations of the thoracic tergum. However, his evidence does not show that the ancestors of the Pterygota were terrestrial, and not aquatic.

* *Zool. Jahrb., Abth. f. Anat.*, 17 Bd., pp. 517–572, 7 pls.

In a recent number of the *Bericht über Land- und Forstwirthschaft im Deutsch-Ostafrika* are two articles of an entomological nature. One by V. Lommel on the tsetse-fly,* deals with the distribution of this pest in East Africa, and its habits. The other is by Dr. A. Zimmerman† and treats of African coffee insects. The most injurious species is the common coffee leaf-miner (*Cemiostoma coffeella*). An unnamed pentatomid does considerable injury to the coffee beans by puncturing them; quite possibly it gives entrance to some fungus. It seems strange to see a work published in Germany with good figures of insects but without their scientific names, which could easily have been supplied by German entomologists.

The last number of 'Fauna Arctica'‡ contains articles on the hymenoptera, hemiptera and siphunculata of the Arctic regions. The former is by Kiaer and Friese, the latter two by Breddin. There is a good bibliography, and many notes on distribution and time of flight in bees. No new species are described; but there is a fine colored plate representing sixteen species of *Bombus*.

Dr. Otto Schenk, of Jena, treats of the sense organs on the antennal surface of some lepidoptera and hymenoptera.§ He considers the sexual differences in the antennæ of these insects, the structure of the sense organs and their probable function. He arranges these sense organs in several classes, and concludes that most of them are for the detection of odors; but that the *sensilla ampullacea* or 'pits of Forel,' are probably hearing organs.

Dr. L. Melichar has recently completed his monograph of the Flatidæ of the world.||

* Bd. 1, Heft 4, pp. 34–350, 1903.

† *Ibid.*, pp. 358–374, 1 pl. (colored).

‡ 'Fauna Arctica,' II., Lief. III., December, 1902.

§ *Zool. Jahrb., Abth. f. Anat.*, 17 Bd., pp. 573–616, 2 pls.

|| 'Monographie der Acanaloniiden und Flatiden,' Ann. Naturhist. Hofmuseums, Wien, 1902.

Over 90 genera and 525 species are treated. Only about 15 species occur in the United States, although several described by Say are unknown to the author. The Malay archipelago and Madagascar are especially rich in large and curious forms. The article is illustrated by nine plates.

Professor F. Meunier has given us another article on the dipterous fauna of the amber.* He describes species of Tabanidæ, Xylophagidæ, Leptidæ and Empidæ. But what is perhaps of most interest is a diopsid, *Sphyracephala breviata,* very similar to the one species occurring in the eastern United States.

Mr. R. Shelford has published an interesting article on insect mimicry in the Malay region.† There is a systematic arrangement of the cases of Batesian mimicry according to the natural orders, details being given in each case. This is followed by a chapter on convergent groups. Several Müllerian associations are represented, particularly the lycoid, coccinellid, and that of melipona. There is an appendix with descriptions of the new species by various specialists. It is illustrated by five colored plates. The cases figured, as well as those figured by Marshall from South Africa, are no more striking than can be found in the insects of our own country.

THE *Anales Sociedad Espanola de Historia Natural,* Vol. XXX., 1902, contains several entomological articles. Uhagon completes his revision of the Malachidæ of Spain; M. Medina y Ramos gives a synopsis of the Spanish Chrysididæ (101 in number); and A. Martinez y Fernandez-Castillo gives a revision of the group Calopteni of the grasshoppers, treating the known forms of the world; none of which, however, occurs in the United States.

An increase in entomological activity in South America is indicated by Volume V. of the *Revista Museu do Paulista* (São Paulo, Brazil, 1902), which contains three large papers on insects. One of two hundred pages with fine plates is by H. W. Broleman on the myriapoda of the Museum of São Paulo. Another is descriptive of the solitary bees of Brazil. It is by C. Schrottky, synoptic in form, illustrated by two plates, and contains notes on the habits of some species. The third article is by J. G. Foetterle on new Brazilian lepidoptera, illustrated by four handsomely colored plates, and describes fourteen species.

Dr. L. Sander has published a long account of locust invasions of the German colonies in Africa.* The migratorial African grasshoppers are species of *Pachytylus* and *Schistocerca,* the latter similar to those of South America. The author gives an historical account of the ravages of locusts, followed by chapters on structure and life-history. He considers the causes and extension of the migrations, and the various natural enemies, especially birds, that prey upon the pests. A large part of the book treats of remedies, chiefly a history of what has been done in other countries, much attention being given to American methods. An appendix contains an old German edict against grasshoppers.

M. Neveu-Lemaire has devised a new classification of the Culicidæ.† After an historical review he criticizes the classification of Theobald, and proposes his new arrangement based on mouth parts and venation. He divides the family into four subfamilies: Anophelinæ (including only *Anopheles*), Megarhininæ (two genera); Culicinæ (with eight genera); and Aëdëinæ (with six genera). He indicates the type species of each genus.

NATHAN BANKS.

* 'Etudes des quelques Diptères de l'Ambre,' *Ann. Sci. Nat. Zool.*, XVI., December, 1902, pp. 395–405, 1 plate.

† 'Observations on Some Mimetic Insects and Spiders from Borneo and Singapore,' *Proc. Zool. Soc. London,* 1902, II. (1903), pp. 230–281.

* 'Die Wanderheuschrecken und ihre Bekämpfung in unseren afrikanischen Kolonieen,' Berlin, 1902, pp. 344, figs. and maps.

† 'Classification de la famille des Culicides,' *Mém. Soc. Zool.*, France, 1902, pp. 195–227 (1903).

THE HARPSWELL LABORATORY.

THE EDITOR OF SCIENCE asks an account of the Harpswell Laboratory. It is easy to comply, for this biological station is one of the most unpretentious structures one could imagine, as will readily be understood when it is said that the whole plant—land, building

and permanent equipment—has cost within $1,000. A one-story, wooden building, measuring 24 x 42 feet on the ground, with sixteen windows, stands directly on the rocky shore a little to one side of a sandy beach. Inside, the space is divided up into nine rooms for investigators and a larger room accommodating from six to ten more elementary students. At either end are large double doors, and the building is so oriented that in the summer the prevailing southwest wind blows straight through the laboratory, keeping the temperature down on the warmest days. In the past two years there has been but one day when the thermometer has gone above 78° F. in the laboratory.

A considerable portion of the equipment is taken each year from Tufts College, to which institution the laboratory belongs, but there is also something of permanent equipment. Thus the laboratory owns two rowboats, dredges, seines and tangles, abundant glassware, several small microscopes, minor apparatus and the nucleus of a library on morphology and marine biology. The stock of chemicals and reagents is large. It has not yet been found possible to introduce running water into the laboratory, but simple makeshifts have made its absence less of a drawback than might be supposed possible.

The laboratory was established with two objects in view—to furnish a place where the instructors and students of the college could go for summer work, and, second—and this far more important—to ascertain the suitability of the location for a research station for the northern fauna and flora.

As is well known, there are three distinct faunæ on the Atlantic coast of North America—a boreal, a temperate and a subtropical, the last passing into the tropical at the southern end of Florida. The boundaries between these three faunæ are approximately Cape Cod and Cape Hatteras. For the middle or temperate fauna there are already three well-equipped biological stations—the Marine Biological Laboratory and the station of the U. S. Fish Commission at Woods Hole, and the Cold Spring Laboratory of the Brooklyn Institute on Long Island. For the southern fauna there is only the recently erected station of the U. S. Fish Commission at Beaufort, N. C. There certainly should be another farther south, but, having no knowledge of locations and conditions, I am not competent to speak of the merits of the Tortugas advocated in these pages by Dr. Mayer. For the stretch of coast from Cape Cod to Eastport (and extending down into the provinces) there is but the small Harpswell Laboratory.

A few statistics will show the richness and peculiarities of this northern fauna. Before we began our work at Harpswell 517 species of invertebrates had been reported from Casco Bay, this list being largely the result of a single summer's work in the region by the U. S. Fish Commission. In a single haul of the dredge a few miles from our laboratory 118 species were obtained. In the region around Woods Hole, Verrill's report on the invertebrata records 660 species from an area about the size of Casco Bay. Of course, subsequent collections and investigations have largely increased both these lists, but these figures, based upon about the same amount of work, show that this northern region is not far inferior to the other in the number of species.

Another comparison has even more interest. Of the 517 species from Casco Bay 273 are not included in Verrill's list of the invertebrata of Vineyard Sound. In other words, over 52 per cent. of the species occurring in Casco Bay were not then known south of Cape Cod. Of course, since these lists were made up the range of many species has been extended, and forms once known only north of Cape Cod have been found south of that promontory, and hence the percentage mentioned must be altered. Yet it is probable that at least a quarter, if not even a third, of the forms found in Casco Bay are either entirely wanting from or very rare in the waters around Woods Hole.

It is a well-known fact in the distribution of marine life that while the number of species is smaller in colder than in warmer waters, the number of individuals of a spe-

cies increases with the latitude, until, at last, the Arctic regions are noted for the immense numbers of individuals of certain species. Hence, other things being equal, the more northern the spot, the more abundant the material and the better the location for a research laboratory. Therefore, from this one standpoint Eastport may possibly hold the supremacy over other points on the New England coast north of Cape Cod. Its reputation as a collecting ground is great, and, since the days of Stimpson, numerous naturalists have gone there for material.

In the discussion of a location for our laboratory the claims of Eastport were considered, but the place was passed by in favor of South Harpswell for the following reasons: The laboratory must be comparatively easy of access. Students should be able to reach it with the least possible expense and trouble, and there must be adequate market facilities for the boarding places of those working at the laboratory. Eastport may be reached by rail by a long, circuitous and expensive journey, or by boat in twenty-four hours from Boston only on alternate days. Again, the facilities for obtaining board are such that the laboratory, as at Woods Hole, would be compelled to establish its own dining hall, and to maintain it under great difficulties and inconveniences. At South Harpswell there are numerous good hotels and boarding houses and the supplies are of the best. So, too, laboratory supplies, bought with all possible foresight, occasionally become exhausted and must be replenished at short notice. Nothing could be obtained at Eastport in less than two days. Harpswell is distant but two hours from the large wholesale city of Portland, and our experience has been that every chemical and reagent desired could be obtained from there on short notice.

Then, Eastport lies in the very center of the region of fogs, a most serious drawback, not only to the pleasures of life, but to research as well. When all the material studied must be obtained from the sea, it will be readily seen that two or three days of continuous fog might seriously interfere with a piece of research. The farther west on the Maine coast, the less numerous the fogs. At Harpswell, last year, from the middle of June to the middle of September there were only seven days when there was any fog.

Casco Bay is about twenty-five miles across, from Cape Elizabeth to Cape Small Point, and it indents the coast about a dozen miles. This whole area is cut up by numerous peninsulas—'necks' or 'points' of local terminology—and dotted by islands, the number of which passes into the hundreds, affording miles upon miles of shore collecting and between them every variety of bottom. Almost no fresh water empties into the bay, while the considerable tides—about ten feet—cause strong currents, and these bring in constantly —to use a paradoxical expression—the freshest of salt water. South Harpswell itself is at the tip of a narrow neck about ten miles long at just about the middle of the bay. It is fourteen miles from Portland, with which place it is connected, during the summer season, by five boats a day each way.

The laboratory has been practically open but two seasons, and its output of published work is as yet small. The list includes:

A. B. Lamb: 'The Development of the Eye Muscles in *Acanthias*,' *Journal of Anatomy*, Vol. I., 1902.

J. S. Kingsley: 'Preliminary Catalogue of the Marine Invertebrata of Casco Bay,' *Proc. Portland Society of Natural History*, II., 1901.

J. S. Kingsley: 'Additions to the Recorded Fauna of Casco Bay,' *l. c.*, 1902.

Frank S. Collins: 'An Algologist's Vacation in Maine,' *Rhodora*, IV., 1902.

G. M. Winslow: 'Note on the Circular Swimming of Sand Dollar Spermatozoa,' SCIENCE, XVII., 1903.

E. B. Wilson: 'Experiments on Merogony in Nemertine Eggs, with Reference to Cleavage and Localization,' SCIENCE, XVII., 1903.

Here might also be mentioned the paper of Dr. C. B. Wilson, 'On the Embryology of *Cerebratulus*,' and the several papers by Dr. Gilman A. Drew upon the structure and development of the molluscs *Nucula*, *Solemya* and *Yoldia*. The work was done in Harpswell,

but before the establishment of the present laboratory. There are now several important papers in progress, but these can hardly be mentioned until their publication.

In the summer of 1902 considerable attention was paid to the plankton, and almost every night showed novelties and interesting forms. Almost all the common types of larvæ occurred abundantly—*Cyphonautes, Mitraria,* Loven's larva, *Pilidium,* plutei and *Bipinnaria,* etc. More noticeable, however, was *Actinotrocha,* the first time the genus has been noticed north of Newport. On several evenings the rare pteropod *Spirialis gouldii* was abundant, while on others there were numbers of the larvæ of a gymnosomatous pteropod (possibly *Clione*) recalling the oft-copied figures of *Pneumodennon* larvæ. Towards the end of the season several specimens of the strange annelid *Tomopteris,* some with eggs, were taken, and we obtained several specimens of *Arachnactis,* the young of the peculiar sea-anemone, *Cerianthus,* which, by the way, is not uncommon in the deeper waters of the bay. The locality possibly offers a good chance to obtain the development of the Copelate Tunicata, as specimens of an *Appendicularia*-like form, some with apparently ripe eggs and spermatozoa, were abundant. Numerous specimens of chain salpæ were brought us by fishermen from the trawling grounds outside.

The student of elasmobranch embryology will find this a most favorable place for work, for the common dog-fish *Acanthias,* is abundant just outside the islands during most of the summer, and embryos are readily obtained from the first appearance of the blastoderm up to those an inch or two in length.

On the whole, our experience has been that no spot north of Cape Cod can excel South Harpswell as a location for a station for biological research. The present laboratory, while well adapted for elementary instruction, is, in many respects, inadequate to the demands liable to be made upon it when the richness of the fauna and the charms of the place become better known.

J. S. Kingsley.

*THE SOUTH AFRICAN ASSOCIATION.**

The inauguration of the South African Association for the Advancement of Science took place at Cape Town on April 27. The *Cape Times,* to which we are indebted for the details of the proceedings, describes the successful gathering as a British Association meeting in miniature. The new Association enters upon its career with a membership of seven hundred persons from many parts of South Africa.

The main objects of the organization are the same as those of the parent body. As defined in the Constitution, they are "to give a strong impulse and systematic direction to scientific inquiry; to promote the intercourse of societies and individuals interested in science in different parts of South Africa; to obtain a more general attention to the objects of pure and applied science, and the removal of any disadvantages of a public kind which may impede its progress."

The presidential address was delivered by Sir David Gill, K.C.B., the Astronomer Royal for South Africa, who explained the nature of the work which it was hoped the new Association would accomplish. During the course of his able address Sir David Gill announced that Lord Kelvin had written that, although in 1905 he will be eighty-one years of age, he intends, if he is as well then as he is now, to accompany the British Association on the visit to South Africa.

The work of the sections began on the second day of the meeting. The presidential addresses in the various sections were delivered by the following men of science:

Section A, Astronomy, Chemistry, Mathematics, Meteorology and Physics, by Profesor P. D. Hahn; Section B, Anthropology, Ethnology, Bacteriology, Botany, Geography, Geology, Mineralogy and Zoology, by Dr. R. Marlotti; and Section C, Archeology, Education, Mental Science, Philology, Political Economy, Sociology and Statistics, by Dr. Thomas Muir, C.M.G., F.R.S., Director of Education for Cape Colony.

Among the papers read during the course of the meetings the following deserve mention. In Section A, on ferments causing 'casse' in wine, by Mr. Raymond Dubois; meteorology in South

* From *Nature.*

Africa: a retrospect and prospect, by Mr. C. M. Stewart; close binary systems, by Dr. Alex. W. Roberts; determination of mean temperature, etc., from observations made at second-order stations on the Table Land, by Mr. J. R. Sutton; some recent work on the discharge of electricity from heated bodies, by Professor J. C. Beattie.

In Section B, (1) on the occurrence of an epidemic among the domesticated animals in Mauritius in which Trypanosomata were found in the blood; (2) note on the correlation of several diseases occurring among animals in South Africa; (3) on the production of a malarial form of South African horse sickness, by Dr. Alex. Edington; the minerals of some South African granites, by Mr. F. P. Mennell; on the classification of the Theriodonts and their allies, by Dr. R. Broom; (1) some morphological and biological observations on the genus *Anacampseros;* (2) on some stone implements in the Albany Museum, by Dr. S. Schonland.

In Section C, some aspects of South African forestry, by Mr. D. E. Hutchins; dry crushing of ore preparatory to the extraction of gold, by Mr. Franklin White; sewage disposal in Cape Colony, by Mr. J. Edward Fitt.

In Section D, the library system of South Africa in comparison with those of England and America, by Mr. Bertram L. Dyer; iteration as a factor in language, by Professor W. Ritchie; common sense and examination, by Mr. P. A. Barnett; Cape Dutch, by Professor W. S. Logeman; how we get knowledge through our senses, by Rev. Dr. F. C. Kolbe.

The example set by the British Association of arranging for receptions and other social functions to lighten the intellectual fare provided was followed at Cape Town, and the excursions, conversazioni, etc., were well attended and much appreciated.

SCIENTIFIC NOTES AND NEWS.

THE University of Pennsylvania has conferred its Doctorate of Laws on Dr. Charles D. Walcott, director of the U. S. Geological Survey, and on Dr. F. P. Venable, now president and formerly professor of chemistry at the University of North Carolina. The university has conferred its doctorate of science on Colonel William Gorgas, U.S.A.

COLUMBIA UNIVERSITY has conferred the degree of Doctor of Science on Dr. J. J. Thomson, Cavendish professor of physics at Cambridge University, and on Mr. Peter Cooper Hewitt, known for his researches and inventions in electrical science.

OXFORD UNIVERSITY will confer its Doctorate of Science on M. Henri Poincaré, professor of mechanics at Paris, and on Mr. M. H. N. Story-Maskelyne, formerly professor of mineralogy in the university.

BY a vote of the Corporation of Harvard College a bronze tablet has been placed in the Museum of Comparative Zoology under the portrait of Dr. Alexander Agassiz. The tablet bears this inscription: 'Alexander Agassiz. This memorial of his great services to science and the University, given by his friends, is placed here by special vote of the President and Fellows and Board of Overseers.'

THE Albert Medal of the Society of Arts, London, for the year 1903, has been awarded to Sir Charles Augustus Hartley, K.C.M.G., in recognition of his services, extending over forty-four years, as engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to ships of all nations, and of his similar services, extending over twenty years, as British commissioner on the International Technical Commission of the Suez Canal.

A CHAPTER of the scientific society of the Sigma Xi has recently been organized at the University of Michigan with Professor J. P. McMurrich as president.

ACCORDING to the *American Geologist* Mr. Bailey Willis has accepted the position of leader of the Carnegie Geological Expedition to China, which has as its object the investigation of the Cambrian of that country. He will be assisted by Mr. Eliot Blackwelder, of the University of Chicago. Mr. Willis expects to leave Washington in July, to attend the International Congress of Geologists at Vienna, and to go to China *via* Siberia. Dr. H. Foster Bain has accepted an appointment as geologist on the United States Geological Survey, and during Mr. Bailey Willis's absence in China will be acting editor of geologic folios. He is to take up the study of

the lead and zinc deposits of the Mississippi valley, and during the coming summer will make special investigations concerning the deposits in southern and northwestern Illinois.

General A. W. Greeley, chief of the U. S. Signal Service Office, has returned to the United States after attending the International Telegraphers' Conference in London.

Professor F. E. Lloyd, of Teachers College, Columbia University, left June 13, by the Steamer *Caribee* for the island of Dominica, where, in the company of Mrs. Lloyd, he will spend the summer in the study of the flora. The expedition is being conducted under the auspices of the New York Botanical Garden. The systematic collections will become a part of the garden herbarium. Professor Lloyd has received a grant of $200 from the Esther Herrman research fund of the Scientific Alliance of New York, to aid him in the collection of tropical Rubiaceae to be used in the furtherance of his researches in the embryology of that order.

Professor and Mrs. Robert H. Richards, of the Massachusetts Institute of Technology, left Boston on June 14 to make a tour of inspection of the principal centers of the mechanical preparation of low grade ores on the Pacific coast.

Professor John C. Merriam, of the University of California, has returned to Berkeley from the fossil beds in Idaho.

Mr. George G. MacCurdy, curator of the anthropological collections of the Peabody Museum, of Yale University, has sailed for Europe, where he will make purchases for the museum.

Messrs. A. F. Blakeslee and J. R. Johnston, of the Graduate School of Harvard University, will spend the summer vacation on Trinidad island for the purpose of collecting botanical specimens for the university.

Silas P. Beebe, M.S., who has been engaged in research work in the laboratory of physiological chemistry in the Sheffield Scientific School of Yale University, has been appointed physiological chemist in connection with the Huntington Fund for Cancer Research in the Loomis Laboratory, New York.

Dr. John Gifford, of the New York State College of Forestry, has tendered his resignation as assistant professor of forestry. He will leave in a few days to investigate the reservation in Porto Rico for the Bureau of Forestry.

Mr. Albert Kingsbury, professor of applied mechanics, at the Worcester Polytechnic Institute, has resigned in order to accept a position as mechanical engineer with the Westinghouse Electrical and Manufacturing Company of Pittsburgh.

Leo F. Rettger, Ph.D., instructor in bacteriology in the Sheffield Scientific School of Yale University, sailed for Europe on June 10. He will spend some time at Strasburg studying bacteriology and bacteriological chemistry.

The Geological Society, London, has made the first award of the proceeds of the fund founded by the late Mr. Daniel Pidgeon, F.G.S., to Dr. Ernest Willington Skeates, of the Royal College of Science.

A committee of eminent chemists has been formed to erect a monument at Heidelberg in memory of Robert Bunsen. It is intended that the contribution shall be international and may be sent to the treasurer, Herr A. Rodrian, Heidelberg.

A portrait of Dr. David Little, formerly lecturer of ophthalmology in Owens College, Manchester, was unveiled on May 27.

Dr. A. A. Common, F.R.S., president of the Royal Astronomical Society in 1895, well-known for his important researches in astronomy, especially in connection with reflecting telescopes, died on June 2, at the age of sixty-two years.

The famous paleontological collection of the Baron de Bayet, of Brussels, Belgium, has been purchased by Mr. Andrew Carnegie and presented by him to the Carnegie Museum at Pittsburgh. It is a vast collection, exceedingly rich in reptilia, fishes, invertebrates and plants from almost all the classic localities in Europe. There is a splendid series of Rhamphorhynchus, Teleosaurus, Ichthyosaurus, Pterodactylus, Mosasaurus and

other colossal reptiles. The collection of Chelonians is large. There are five skeletons of *Crocodilus vicentinus* from Italy. A thousand species of fossil fishes are represented, among them a splendid assemblage of specimens from the old red sandstone of Scotland. There is a splendid collection of fossil insects from Solenhofen, and a number of magnificent slabs showing the palm trees of Monte Bolca. One slab has upon it the stem, roots and seven leaves of a dwarf palm. There has been hitherto no representative collection of the fossils of Europe on this side of the Atlantic, and the acquisition of this splendid and very costly collection at one stroke puts the section of paleontology of the Carnegie Museum in a position to make it a point of central attraction to American students, who may desire to institute comparisons between the extinct fauna and flora of Europe and America.

THE exhibition room on the second floor of the Peabody Museum, Harvard University, formerly used for the Semitic collections, has been fitted with ethnological collections, mostly relating to the Indian tribes along the west coast of America.

THE British Anatomical Society will hold its summer meeting this year at University College, Liverpool, on June 19 and 20.

A MEETING of the council of the International Association of Academies was held during the first week of this month, at the rooms of the Royal Society, that society being the directing academy of the association for the three years' period ending with 1904. *Nature* states that the meeting was attended by delegates from nearly all the principal learned academies of Europe, who discussed several matters of importance to international science and philosophy, preparatory to the meeting of the general assembly which is to be held in London next year. Representatives of both sections of the association, the natural science section and the history and philosophy section, attend the council. In connection with the meeting of the council there was a meeting of a special committee appointed to deal with a proposal for the establishment of an international organization for the investigation of the anatomy of the brain. The foreign delegates were received by the president and fellows of the Royal Society at Burlington House on June 3.

THE International Congress for applied chemistry was formally opened on June 3. We learn from notices in *Nature* and the *Times* that Geheimrath Professor Dr. Otto Witt presided, and there was a large gathering of leading authorities on chemistry from all parts of the world. Speeches were delivered by Count Posadowsky, Imperial Secretary of State for the Interior, and Dr. Studt, Prussian minister of education. They referred to the enormous importance of applied chemistry both for industry and agriculture, and instanced among other achievements the development of the production of beetroot sugar. Dr. Studt stated that in Germany alone chemical industries created products to the value of more than one milliard of marks. Among the foreign delegates who spoke were Professor Moissan, president of the Paris Chemical Society, Professor Tilden, of the Royal College of Science of London, Professor Ludwig, from Vienna, and Professor Jakobkin, from St. Petersburg. About 2,200 members were present. The Congress was divided into eleven sections and three subsections. The German Electrochemical Society, which last year adopted the name of German Bunsen Society for Applied Physical Chemistry, also held its annual meeting at Berlin during the week, and took charge of the electrochemical section. There were 350 papers and reports on the program.

THE Civil Service Commission will hold a competitive examination during the summer or fall to fill a position as assistant chemist in the Geological Survey, salary $1,200. No applicants who are unable to do independent research work in mineralogy and crystallography will be considered. Ability to do independent chemical research work, while desired, is not an essential condition, although a good knowledge of analytical chemistry is demanded. For information as to dates and places for holding the examination and sub-

jects to be covered applicants should address the Civil Service Commission at Washington. It is probable that another position as assistant chemist will be open to competition in the Geological Survey during the summer. The position is one paying $1,800 per annum. Only a fair knowledge of mineralogy will be required of applicants for it, but they must be men of experience, well versed in chemical analysis, and able to do independent work on problems relating to geology. The examination in this latter case will not be of the usual kind, but the markings will be based on education and technical experience, a thesis of a thousand words and published work. As the filling of this position is not yet in the hands of the Civil Service Commission, inquiries and addresses should be sent to the director of the Geological Survey, at Washington.

THERE will be a civil service examination on July 29 and 30 to fill positions of assistant engineers and hydrographers in the U. S. Geological Survey at a salary of $60 a month.

Nature states that the twenty-first congress of the Sanitary Institute will be held at Bradford on July 6–11. The inaugural address to the congress will be delivered by the president, the Right Hon. the Earl Stamford. Numerous sectional meetings will be held, the sections with their presidents being as follows: (1) Sanitary science and preventive medicine, Professor T. Clifford Allbutt, F.R.S.; (2) engineering and architecture, Mr. Maurice Fitzmaurice, C.M.G.; (3) physics, chemistry and biology, Professor C. Hunter Stewart. On July 8 there will be conferences of those engaged in the various branches of practical sanitary science, and in the evening a *conversazione* and reception by the mayor of Bradford. The concluding day will be devoted to excursions.

THE report by Dr. Joseph Struthers to the United States Geological Survey on sulphur and pyrite in 1902 is now in press. The production of sulphur in the United States in 1902 was 8,336 short tons, valued at $220,560, as compared with 7,690 tons, valued at $223,430, in 1901, and 3,525 tons, valued at $88,100, in 1900. The production in 1902 was derived from Louisiana, Nevada and Utah, in the order of the importance of their output. Oregon and Idaho, which contributed to the output during 1901, reported no production for 1902. The quantities of sulphur produced in the United States during 1901 and 1902 are the largest annual outputs that have been recorded. Up to 1901 the production of domestic sulphur averaged less than one per cent. of the total consumption, an insignificant amount compared with the foreign imports, which amounted in 1902 to 174,939 long tons. The quantity of sulphur consumed in the United States from foreign and domestic sources, including the sulphur content of iron pyrite, which is used in the manufacture of sulphuric acid, amounted to 510,106 long tons. By far the greater part of the sulphur consumed in the United States is used in the manufacture of paper stock by the sulphite process. The production of pyrite in 1902 reached the largest annual output yet attained in the United States, 290,973 long tons, valued at $1,219,210, exceeding the previous record in 1901 of 234,825 long tons, valued at $1,024,449, by 23.9 per cent. in quantity and 19 per cent. in value. Of the total output, Virginia contributed nearly one-half, followed by Georgia and North Carolina, Colorado, Massachusetts, California, Indiana and Ohio, Missouri and New York, in the respective order of the quantities of output. In addition to the large increase in the production of pyrite in the United States during 1902, there was a very large increase in the quantity of pyrite imported, the statistics of imports for 1902 and 1901 being respectively 440,363 long tons ($1,650,852) and 403,706 long tons ($1,415,149). The increased use of pyrite for acid making has been due both to the development of the sulphite wood-pulp industry for manufacturing paper and to the increased domestic manufacture of superphosphates, consequent upon the increased production of phosphate rock from Florida and Tennessee.

AT a special meeting of the Physical Society, held in London, on June 8, with the president, Dr. R. T. Glazebrook in the chair, Professor E. Rutherford, of McGill Univer-

sity, Montreal, read a paper on 'Radio-active Processes.' According to the report in the London *Times* he pointed out that the radioactive bodies uranium, thorium and radium were continuously and apparently spontaneously giving off three distinct types of radiation. There were, first, the α rays, which were projected bodies, flights of positively charged material particles, which were prominent in causing conductivity in gases, were easily absorbed, moved with great velocity, and carried a large amount of energy. Secondly, there were the β rays, which were apparently the same as the cathode rays of ordinary vacuum tubes, though they traveled faster, and hence had very considerable penetrating powers. They were negatively charged. Thirdly, there were the γ rays, which appeared very similar to ordinary X-rays. In addition some of the substances gave off something else. Thorium oxide, for example, emitted an emanation which appeared to be matter in gaseous state, and could be carried along by air-streams, and radium gave a similar emanation, which differed from that of thorium in that its effects were far more persistent. These emanations behaved like radio-active gases; their diffusion could be measured, and they could be occluded in radioactive bodies, while the fact that they could be condensed by the cold of liquid air rendered them difficult of explanation except on the assumption that they consisted of material bodies. These emanations induced or excited radio-activity in every body in their neighborhood, and this excited activity, like that of the emanations, decayed at a constant rate. Apparently the emanations themselves could not be affected by any chemical treatment, but behaved like inert gases, wherein they differed from the excited activity which chemical treatment did affect. It had been found possible to separate from radio-active bodies a radio-active constituent; thus by a chemical method Crookes had removed all activity from uranium, and the lecturer and Mr. Soddy had found that the radio-active constituent, which might be called thorium X, could be separated from thorium. In time, however, the former lost its activity and the latter regained it. It seemed as if radio-active bodies were continually undergoing some change by which new substances were being produced; thus thorium from which all the thorium X had been removed would in a few weeks yield as much as before. The radiations had a close connection with chemical changes. It might be supposed that the atoms of the radio-active bodies were in a state of unstable equilibrium, and sent off positively charged bodies. But the thorium atom which had sent off such a positive body was chemically altered, and thorium X was equivalent to thorium *minus* the expelled body. The thorium X atom was also unstable, and in turn threw off another positive body, and so the process went on, the changes that occurred being measured by the activity of the preceding stage. The main radio-active processes threw off positive bodies, which were thus the most important, and negative electrons and cathode rays only appeared in the last stages. It was to expected that only a small number of α rays would be thrown off; these were quickly absorbed, and thus the radium was subject to bombardment by itself, with the result that it grew hot and maintained its temperature above that of its surroundings, as observed by Curie. The amount of energy given out was enormous; it might be calculated that a gram of radium during its life would give out enough to raise 500 tons a mile high. But there was no reason why such huge stores of energy should be thought to exist only in radio-active bodies; they might exist in every atom, although we had not yet happened to obtain any knowledge of their existence.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT BUTLER announced at the commencement exercises of Columbia University that the trustees had decided to purchase the two blocks of land south of the present site of the university at a cost of $2,000,000. He also announced a gift of $300,000 from Mrs. Helen Hartley Jenkins and Mr. Marcellus Hartley Dodge, a member of the senior class,

for a dormitory; and of $100,000 from General Horace W. Charpentier for the School of Law, part of which is to be used for the establishment of special lectures on the science of law.

Boston University has received a gift of $100,000, which will be used to purchase the building on the corner of Somerset street and Ashburton place.

Harvard University has established a course in forestry, and Mr. R. T. Fisher has been appointed instructor in this subject.

Trustees have been appointed to the newly organized University of Porto Rico.

Union College is one of the very few reputable institutions which persists in conferring the degree of Ph.D., *honoris causa.* It has conferred the degree this year on one of our most eminent electrical engineers, who is incidentally professor at the college.

A correspondent has sent us a circular letter from the American National Nashville College of Law, offering to bestow upon him the degree of Doctor of Laws on the payment of a fee of $10. This extraordinary institution announces that it has increased its authorized capital stock from $10,000 to $20,000 to enable it to offer courses leading to the degrees of D.C.L. and LL.D. It claims to be incorporated by the commonwealth of Tennessee.

At the commencement exercises of the University of Colorado, at Boulder, degrees were conferred as follows: B.A., 10; B.S., 11; B.Ph., 7; B.S. (C.E.), 5; B.S. (E.E.), 8; M.D., 8; LL.B., 11; M.A., 4. At the same institution Professor R. D. George, assistant professor of geology at the University of Iowa, has been called to a full professorship of geology.

Dr. Charles S. Palmer has resigned the presidency of the Colorado State School of Mines and will be succeeded by Dean Victor C. Alderson, of the Armour Institute of Technology.

Dr. H. B. Fine, professor of mathematics of Princeton University, has been elected dean.

Dr. Charles Palache, assistant professor of mineralogy at Harvard University, and Dr. J. R. Angell, associate professor of experimental psychology at the University of Chicago, will lecture in the summer school of the University of California.

The following promotions and appointments are announced at Harvard University: Professor Charles R. Sanger, director of the chemical laboratory; Robert W. Willson, professor of astronomy; W. Ernest Castle, assistant professor of zoology; G. W. Pierce and Theodore Lyman, instructors in physics; Assistant Professor H. A. Torrey, of the University of Vermont, instructor in chemistry; J. F. Langmaid, assistant in chemistry; W. S. Tower, assistant in physiography and meteorology; J. M. Greenman, instructor in botany.

Dr. Frederick Neher and Dr. Alexander H. Phillips, of Princeton University, have been promoted to professorships of analytical and organic chemistry and of mineralogy respectively.

Dr. J. Heath Bawden has been promoted to the professorship of philosophy, Vassar College.

Joseph E. Kirkwood, Ph. D. (Columbia), instructor in botany, and Albert M. Reese, Ph.D. (Johns Hopkins), instructor in histology and embryology, have been promoted to associate professorships in Syracuse University.

The following appointments have been made in the Chemical Department of the University of North Carolina for the session 1903–4: R. O. E. Davis, Ph.D, instructor; W. McKim Marriotte and L. B. Lockhart, assistants; Reston Stevenson, M.A. (North Carolina), has accepted a position of assistant in chemistry, Cornell University; H. H. Bennett, Ph.B., assistant in chemistry, has accepted an assistantship in the Soil Survey Laboratory, Washington, D. C.

Miss Onera A. Merritt, who holds degrees from Birmingham and London Universities, has been appointed instructor in zoology at Wellesley College.

F. A. Sager, assistant professor of physics in the University of Illinois, has resigned.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 26, 1903.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*MODERN VIEWS ON MATTER: THE REALIZATION OF A DREAM.**

FOR nearly a century men who devote themselves to science have been dreaming of atoms, molecules, ultramundane particles, and speculating as to the origin of matter; and now to-day they have got so far as to admit the possibility of resolving the chemical elements into simpler forms of matter, or even of refining them altogether away into ethereal vibrations or electrical energy.

This dream has been essentially a British dream, and we have become speculative and imaginative to an audacious extent, almost belying our character of a purely practical nation. The notion of impenetrable mysteries has been dismissed. A mystery is a thing to be solved—'and man alone can master the impossible.' There has been a vivid new start. Our physicists have remodeled their views as to the constitution of matter and as to the complexity if not the actual decomposability of the chemical elements. To show how far we have been propelled on the strange new road, how dazzling are the wonders that waylay the researcher, we have but to recall—matter in a fourth state, the genesis of the elements, the dissociation of

* An address delivered before the Congress of Applied Chemistry at Berlin, June 5, 1903, from proof under correction.

the chemical elements, the existence of bodies smaller than atoms, the atomic nature of electricity, the perception of electrons, not to mention other dawning marvels far removed from the lines of thought usually associated with English chemistry.

The earliest definite suggestion in the last century of the possible compound nature of the metals occurs in a lecture delivered in 1809* by Sir Humphry Davy at the Royal Institution. In that memorable lecture he speculated on the existence of some substance common to all the elements, and he averred that "If such generalizations should be supported by facts, a new, a simple and a grand philosophy would be the result. From the combination of different quantities of two or three species of ponderable matter we might conceive all the diversity of material substances to owe their constitution."

Again, in 1811, he said:† "It will be useless to speculate upon the consequences of such an advancement in chemistry as that of the decomposition and composition of the metals. * * * It is the duty of a chemist to be bold in pursuit. He must not consider things as impracticable merely because they have not yet been effected. He must not regard them as unreasonable because they do not coincide with popular opinion. He must recollect how contrary knowledge sometimes is to what appears to be experience. * * * To inquire whether the metals be capable of being decomposed and composed is a grand object of true philosophy."

Davy first used the term 'radiant matter' about 1809, but chiefly in connection with what is now called radiation. He also used the term in another sense, and the following passage‡ in its clear forecast is prophetic of the modern electron: 'If particles of gases were made to move in free space with an almost infinitely great velocity—*i. e.,* to become radiant matter—they might produce the different species of rays, so distinguished by their peculiar effects.'

In his lectures at the Royal Institution, in 1816, 'On the General Properties of Matter,' another prescient chemist, Faraday, used similar terms when he said: "If we conceive a change as far beyond vaporization as that is above fluidity, and then take into account also the proportional increased extent of alteration as the changes rise, we shall, perhaps, if we can form any conception at all, not fall far short of radiant matter; and as in the last conversion many qualities were lost, so here also many more would disappear." again, in one of his early lectures he strikes a forward note: "At present we begin to feel impatient, and to wish for a new state of chemical elements. To decompose the metals, to reform them, and to realize the once absurd notion of transmutation, are the problems now given to the chemist for solution."

But Faraday was always remarkable for the boldness and originality with which he regarded generally accepted theories. In 1844 he said, "The view that physical chemistry necessarily takes of atoms is now very large and complicated; first many elementary atoms—next compound and complicated atoms. System within system, like the starry heavens, *may be right* —but may *be all wrong.*"

A year later Faraday startled the world by a discovery to which he gave the title 'On the Magnetization of Light and the Illumination of the Magnetic Lines of Force.' For fifty years this title was misunderstood and was attributed to enthusiasm or confused ideas. But to-day

* 'Works of Sir Humphry Davy,' Vol. VIII., p. 325.

† *Loc. cit.,* Vol. VIII., p. 330.

‡ *Loc. cit.,* Vol. VIII., p. 349.

we begin to see the full significance of the Faraday dream.

In 1879, in a lecture I delivered before the British Association* at Sheffield, it fell to my lot to revive 'Radiant Matter.' I advanced the theory that in the phenomena of the vacuum tube at high exhaustions the particles constituting the cathode stream are not solid, nor liquid, nor gaseous, do not consist of atoms propelled through the tube and causing luminous, mechanic or electric phenomena where they strike, 'but that they consist of something much smaller than the atom—fragments of matter, ultra-atomic corpuscles, minute things, very much smaller, very much lighter than atoms—things which appear to be the foundation stones of which atoms are composed.'†

I further demonstrated that the physical properties of radiant matter are common to all matter at this low density—'Whether the gas originally under experiment be hydrogen, carbon dioxide or atmospheric air, the phenomena of phosphorescence, shadows, magnetic deflection, etc., are identical.' Here are my words, written nearly a quarter of a century ago: "We have actually touched the borderland where matter and force seem to merge into one another‡—the shadowy realm between the known and unknown. I venture to think that the greatest scientific problems of the future will find their solution in this borderland, and even beyond; here, it seems to me, lie ultimate realities, subtle, far-reaching, wonderful."

It was not till 1881 that J. J. Thomson established the basis of the electrodynamic theory. In a very remarkable memoir in the *Philosophical Magazine* he explained the phosphorescence of glass under the influence of the cathode stream by the nearly abrupt changes in the magnetic field arising from the sudden stoppage of the cathode particles.

The now generally accepted view that our chemical elements have been formed from one primordial substance was advocated in 1888 by me when president of the Chemical Society,* in connection with a theory of the genesis of the elements. I spoke of 'an infinite number of immeasurably small ultimate—or, rather, ultimatissimate—particles gradually accreting out of the formless mist, and moving with inconceivable velocity in all directions.'

Pondering on some of the properties of the rare elements, I strove to show that the elementary atoms themselves might not be the same now as when first generated—that the primary motions which constitute the existence of the atom might slowly be changing, and even the secondary motions which produce all the effects we can observe—heat, chemic, electric and so forth—might in a slight degree be affected; and I showed the probability that the atoms of the chemical elements were not eternal in existence, but shared with the rest of creation the attributes of decay and death.

The same idea was expanded at a lecture I delivered at the Royal Institution in 1887, when it was suggested that the atomic weights were not invariable quantities.

I might quote Mr. Herbert Spencer, Sir Benjamin Brodie, Professor Graham, Sir George Stokes, Sir William Thomson (now Lord Kelvin), Sir Norman Lockyer, Dr. Gladstone and many other English *savans* to show that the notion—not necessarily of the decomposability but at any rate of the complexity of our supposed elements

* 'British Association Reports,' Sheffield Meeting, 1879. *Chemical News*, Vol. XL., p. 91. *Phil. Trans. Roy. Soc.*, 1879, Part I., p. 585. *Proc. Roy. Soc.*, 1880, No. 205, p. 469.

† Sir O. Lodge, *Nature*, Vol. LXVII., p. 451.

‡ 'Matter is but a mode of motion' (*Proc Roy. Soc.*, No. 205, p. 472).

* Pres. Address to Chem. Soc., March 28, 1888.

has long been 'in the air' of science, waiting to take more definite development. Our minds are gradually getting accustomed to the idea of the genesis of the elements, and many of us are straining for the first glimpse of the resolution of the chemical atom. We are eager to enter the portal of the mysterious region too readily ticketed 'Unknown and Unknowable.'

Another phase of the dream now demands attention. I come to the earlier glimpses of the electric theory of matter.

Passing over the vague speculations of Faraday and the more positive speculations of Sir William Thomson (now Lord Kelvin), one of the earliest definite statements of this theory is given in an article in the *Fortnightly Review* for June, 1875, by W. K. Clifford—a man who in common with other pioneers shared that 'noblest misfortune of being born before his time.' 'There is great reason to believe,' said Clifford, 'that every material atom carries upon it a small electric current, *if it does not wholly consist of this current.*'

In 1886 when president of the Chemical Section of the British Association, in a speculation on the origin of matter, I drew a picture of the gradual formation of the chemical elements by the workings of three forms of energy—electricity, chemism and temperature—on the 'formless mist' (protyle*), wherein all matter was in the pre-atomic state—potential rather than actual. In this scheme the chemical elements owe their stability to being the outcome of a struggle for existence—a Darwinian development by chemical evolution—a survival of the most stable. Those of lowest atomic weight would first be formed, then those of intermediate weight, and finally the elements having the highest atomic weights, such as thorium and uranium. I spoke of the 'dissociation point' of the elements. "What comes after uranium?" I asked. And I answered back, "The result of the next step will be * * * the formation of * * * compounds the dissociation of which is not beyond the powers of our terrestrial sources of heat." A A dream less than twenty years ago, but a dream which daily draws nearer to entire and vivid fulfilment. I will presently show you that radium, the next after uranium, does actually and spontaneously dissociate.

The idea of units or atoms of electricity —an idea hitherto floating intangibly like helium in the sun—can now be brought to earth and submitted to the test of experiment.* Faraday, W. Weber, Laurentz,

* We require a word, analogous to protoplasm, to express the idea of the original primal matter existing before the evolution of the chemical elements. The word I venture to use is composed of πρό (*earlier than*) and ὕλη (*the stuff of which things are made*).

* "The equivalent weights of bodies are simply those quantities of them which contain equal quantities of electricity; * * * it being the electricity which *determines* the equivalent number, *because* it determines the combining force. Or, if we adopt the atomic theory or phraseology, then the atoms of bodies which are equivalents to each other in their ordinary chemical action, have equal quantities of electricity naturally associated with them." Faraday's 'Experimental Researches in Electricity' par. 869, January, 1834.

"This definite quantity of electricity we shall call the molecular charge. If it were known it would be the most natural unit of electricity." Clerk Maxwell's 'Treatise on Electricity and Magnetism,' first edition, Vol. I., 1873, p. 311.

"Nature presents us with a single definite quantity of electricity. * * * For each chemical bond which is ruptured within an electrolyte a certain quantity of electricity traverses the electrolyte, which is the same in all cases." G. Johnstone Stoney, 'On the Physical Units of Nature,' British Association Meeting, Section A, 1874.

"The same definite quantity of either positive or negative electricity moves always with each univalent ion, or with every unit of affinity of a multivalent ion." Helmholtz, Faraday Lecture, 1881.

Gauss, Zöllner, Hertz, Helmholtz Johnstone Stoney, Sir Oliver Lodge, have all contributed to develop the idea—originally due to Weber—which took concrete form when Stoney showed that Faraday's law of electrolysis involved the existence of a definite charge of electricity associated with the ions of matter. This definite charge he called an electron. It was not till some time after the name had been given that electrons were found to be capable of existing separately.

In 1891, in my inaugural address as president of the Institution of Electrical Engineers,* I showed that the stream of cathode rays near the negative pole was always negatively electrified, the other contents of the tube being positively electrified, and I explained that 'the division of the molecule into groups of electro-positive and electro-negative atoms is necessary for a consistent explanation of the genesis of the elements.' In a vacuum tube the negative pole is the entrance and the positive pole the exit for electrons. Falling on a phosphorescent body, yttria, for instance, —a collection of Hertz molecular resonators—the electrons excite vibrations of, say, 550 billion times a second, producing ether waves of the approximate length of 5.75 ten-millionths of a millimeter, and occasioning in the eye the sensation of citron-colored light. If, however, the electrons dash against a heavy metal or other body which will not phosphoresce, they produce ether waves of a far higher frequency than light, and are not continuous vibrations, but, according to Sir George Stokes, simple shocks or solitary impulses; more like discordant shouts as compared with musical notes.

During that address an experiment was shown which went far to prove the dissociation of silver into electrons and positive atoms.* A silver pole was used, and near it in front was a sheet of mica with a hole in its center. The vacuum was very high, and when the poles were connected with the coil, the silver being negative, electrons shot from it in all directions, and passing through the hole in the mica screen, formed a bright phosphorescent patch on the opposite side of the bulb. The action of the coil was continued for some hours, to volatilize a certain portion of the silver. Silver was seen to be deposited on the mica screen only in the immediate neighborhood of the pole; the far end of the bulb, which had been glowing for hours from the impact of electrons, being free from silver deposit. Here, then, are two simultaneous actions. Electrons, or radiant matter shot from the negative pole, caused the glass against which they struck to glow with phosphorescent light. Simultaneously, the heavy positive ions of silver, freed from negative electrons, and under the influence of the electrical stress, likewise flew off and were deposited in the metallic state near the pole. The ions of metal thus deposited in all cases showed positive electrification.†

In the years 1893–1895 a sudden impulse was given to electric vacuum work by the publication in German of the remarkable results obtained by Lenard and Röntgen, who showed that the phenomena inside the vacuum tube were surpassed in interest by what took place outside. It is not too much to say that from this date what had been a scientific conjecture became a sober reality.

"Every monad atom has associated with it a certain definite quantity of electricity; every dyad has twice this quantity associated with it; every triad three times as much, and so on." O. Lodge, 'On Electrolysis,' *British Association Report*, 1885.

* 'Electricity in Transitu: from Plenum to Vacuum,' *Journ. Inst Electrical Engineers*, Vol. XX., p. 10, January 15, 1891.

* In describing the experiment, one of fundamental importance, modern terms are employed.

† *Proc. Roy. Soc.*, Vol. LXIX., p. 421.

Faraday, in 1862, long and ardently sought for a visible relation between magnetism and light which in 1845 he had foreshadowed. But his instrumental means were too feeble, and it was not till 1896 that Zeeman showed a spectrum line could be acted on by a magneic field. A spectrum line is caused by motion of the electron. A magnetic field resolves this motion into other component motions, some slower, others quicker, and thus causes a single line to split into others of greater and less refrangibility than the parent line.

One important advance in theoretic knowledge has been obtained by Dewar, the successor of Faraday in the classic laboratories of the Royal Institution. Soon after Röntgen's discovery Dewar found that the relative opacity to the Röntgen rays was in proportion to the atomic weights of bodies, and he was the first to apply this principle to settling a debated point in connection with argon. Argon is relatively more opaque to the Röntgen rays than either oxygen, nitrogen or sodium, and from this Dewar inferred that the atomic weight of argon was twice its density relative to hydrogen. In the light of to-day's researches on the constitution of atoms, it is impossible to overestimate the importance of this discovery.

In 1896 Becquerel, pursuing the masterly work on phosphorescence inaugurated by his illustrious father, showed that the salts of uranium constantly emit emanations which have the power of penetrating opaque substances and of affecting a photographic plate in total darkness, and of discharging an electrometer. In some respects these emanations, known as Becquerel rays, behave like rays of light, but they also resemble Röntgen rays. Their real character has only recently been ascertained, and even now there is much that is obscure and provisional in the explanation of their constitution and action.

Following closely upon Becquerel's work came the brilliant researches of M. and Mme. Curie, on the radio-activity of bodies accompanying uranium.

Hitherto have been recounting isolated instances of scientific speculation with apparently little relation to one another. The existence of matter in an ultra-gaseous state; material particles smaller than atoms; the existence of electrical atoms or electrons; the constitution of Röntgen rays and their passage through opaque bodies; the emanations from uranium; the dissociation of the elements—all these isolated hypotheses are now focused and welded into one harmonious theory by the discovery of radium.

> "Often do the spirits
> Of great events stride on before the events,
> And in to-day already walks to-morrow."

No new discovery is ever made without its influence ramifying in all directions and explaining much that before had been mystifying. Certainly no discovery of modern times has had such wide-embracing consequences, and thrown such a flood of light on broad regions of hitherto inexplicable phenomena, as this discovery of M. and Mme. Curie and M. Bémont, who patiently and laboriously plodded along a road bristling with difficulties almost insuperable to others who, like myself, have toiled in similar labyrinths of research. The crowning point of these labors is radium.

Let me briefly recount some of the properties of radium, and show how it reduces speculations and dreams, apparently impossible of proof, to a concrete form.

Radium is a metal of the calcium, strontium and barium group. Its atomic weight according to C. Runge and J. Precht is probably about 258. In this case it occupies the third place below barium in my

lemniscate spiral scheme of the elements,* two unoccupied gaps intervening.

The spectrum of radium has several well-defined lines; these I have photographed and have also measured their wave-lengths. Two especially are strong and characteristic. One at wave-length 3,649.71 and the other at wave-length 3,814.58. These lines enable radium to be detected spectroscopically.

The emanations cause soda-glass to assume a violet color, and they produce many chemical changes. Their physiological action is strong, a few milligrams brought near the skin in a few hours producing a wound difficult to heal.

The most striking property of radium is its power to pour out torrents of emanations bearing a certain resemblance to Röntgen rays, but differing in important points.

The emanations from radium are of three kinds. One set is the same as the cathode stream, now identified with free electrons —atoms of electricity projected into space apart from gross matter—identical with 'matter in the fourth or ultragaseous state,' Kelvin's 'satellites,' Thomson's 'corpuscles' or 'particles'; Lodge's 'disembodied ionic charges, retaining individuality and identity.' These electrons are neither ether-waves nor a form of energy, but substances possessing inertia (probably electric). Liberated electrons are exceedingly penetrating. They will discharge an electroscope when the radium is ten feet or more away, and will affect a photographic plate through five or six millimeters of lead and several inches of wood or aluminium. They are not readily filtered out by cotton-wool; they do not behave as a gas, *i. e.*, they have not properties dependent on intercollisions, mean free path, etc.; they act more like a fog or mist, are mobile and carried about by a current of air to which they give temporary conducting powers, clinging to positively electrified bodies and thereby losing mobility, and diffusing on the walls of the containing vessel if left quiet.

* *Proc. Roy Soc.*, Vol. LXIII., p. 408.

Electrons are deviable in a magnetic field. They are shot from radium with a velocity of about one tenth that of light, but are gradually obstructed by collisions with air atoms, so that some become much slowed, and then are what I formerly called loose and erratic particles, which diffuse about in the air, and give it temporary conducting powers. These can turn corners, can be concentrated by mica cones into a bundle and then produce phosphorescence.

Another set of emanations from radium are not affected by an ordinarily powerful magnetic field, and are incapable even of passing through thin material obstructions. These emanations have about one thousand times the energy of those radiated by the deflectable particles. They render air a conductor and act strongly on a photographic plate. Their mass is enormous in comparison with that of the electrons, and their velocity is probably as great when they leave the radium, but, in consequence of their greater mass, they are less deflected by the magnet, are easily obstructed by obstacles, and are sooner brought to rest by collisions with air atoms. The Hon. R. B. Strutt* was the first to affirm that these non-deflectable rays are the positive ions moving in a stream from the radioactive body.

Rutherford has shown that these emanations are slightly affected in a very powerful magnetic field, but in an opposite direction to the negative electrons. They are therefore proved to be positively charged bodies moving with great velocity. For

* *Phil. Trans. R. S.*, A, 1901, Vol. CXCVI., p. 525.

the first time Rutherford has measured their speed and mass, and he shows they are ions of matter moving with a speed of the order of that of light.

There is also a third kind of emanation produced by radium. Besides the highly penetrating rays deflected by a magnet, there are very penetrating rays not at all affected by magnetism. These accompany the previous emanations, and are Röntgen rays—ether vibrations—produced as secondary phenomena by the sudden arrest of velocity of the electrons by solid matter, producing a series of Stokesian 'pulses' or explosive ether waves shot into space.

Many lines of argument and research tending towards the same point give trustworthy data by which to calculate the masses and velocities of these different particles. I must deal with big figures, but big and little are relative, and are only of importance in relation to the limitations of our senses. I will take as the standard the atom of hydrogen gas—the smallest material body hitherto recognized. The mass of an electron is 1/700th of an atom of hydrogen, or 3×10^{-26} grm., according to J. J. Thomson, and its velocity is 2×10^{9} centimeters per second, or two thirds that of light The kinetic energy per milligram is 10^{17} ergs, about three and a half million foot-tons. Becquerel has calculated that one square centimeter of radio-active surface would radiate into space one gram of matter in one billion years.

The positively electrified masses or ions are enormously great in comparison with the size of the electron. Sir Oliver Lodge illustrates it thus: If we imagine an ordinary sized church to be an atom of hydrogen, the electrons constituting it will be represented by about 700 grains of sand each the size of an ordinary full-stop (350 positive and 350 negative) dashing in all directions inside, or, according to Lord Kelvin, rotating with inconceivable velocity. Put in another way; the sun's diameter is about one and a half million kilometers, and that of the smallest planetoid about 24 kilometers. If an atom of hydrogen be magnified to the size of the sun, an electron will be about two-thirds the diameter of the planetoid.

The extreme minuteness and sparseness of the electrons in the atom account for their penetration. While the more massive ions are stopped by intercollisions in passing among atoms, so that they are almost completely arrested by the thinnest sheet of matter, electrons will pass almost unobstructed through ordinary opaque bodies.

The action of these emanations on phosphorescent screens is different. The electrons strongly affect a screen of barium platinocyanide, but only slightly one of Sidot's zinc sulphide. On the other hand, the heavy, massive, non-deflectable positive ions affect the zinc sulphide screen strongly, and the barium platinocyanide screen in a much less degree.

Both Röntgen rays and electrons act on a photographic plate and produce images of metal and other substances enclosed in wood and leather, and throw shadows of bodies on a barium platinocyanide screen. Electrons are much less penetrating than Röntgen rays, and will not, for instance, show easily the bones of the hand. A photograph of a closed case of instruments is taken by radium emanations in three days, and by Röntgen rays in three minutes. The resemblance between the two pictures is slight, and the differences great.

The power with which radium emanations are endowed of discharging electrified bodies is due to the ionization of the gas through which they pass. This can be effected in many other ways; thus,

ionization is communicated to gases faintly by the splashing of water, by flames and red-hot bodies, by ultra-violet light falling on negatively electrified metals, and strongly by the passage of Röntgen rays.

According to Sir Oliver Lodge's electronic theory of matter, a chemical atom or ion has a few extra negative electrons in addition to the ordinary neutral atom, and if these negative electrons are removed it thereby becomes positively charged. The free electron portion of the atom is small in comparison with the main bulk, in the proportion in hydrogen of about 1 to 700. The negative charge consists of superadded or unbalanced electrons—one, two, three, etc., according to the chemical valency of the body—whereas the main bulk of the atom consists of paired groups, equal positive and negative. As soon as the excess electrons are removed, the rest of the atom, or ion, acts as a massive positively charged body, hanging tightly together. In a high vacuum the induction spark tears the components of a rarefied gas apart; the positively charged ions, having great comparative density are soon slowed down by collisions, while the electrons are driven from the negative pole with an enormous velocity depending on the initial electromotive force and the pressure of gas inside the tube, but approaching, at the highest exhaustions, half that of light.

After leaving the negative pole the electrons meet with a certain resistance, in a slight degree by physical collisions, but principally by reunion with the positive ions.

Since the discovery of radium and the identification of one set of its emanations with the cathode stream or radiant matter of the vacuum tube, speculation and experiment have gone hand in hand, and the two-fluid theory of electricity is gradually replaced by the original one-fluid theory of Franklin. On the two-fluid theory, the electrons constitute free negative electricity, and the rest of the chemical atom is charged positively, although a free positive electron is not known. It seems to me simpler to use the original one-fluid theory of Franklin, and to say that the electron is the atom or unit of electricity. Fleming uses the word 'co-electrons' to express the heavy positive ion after separation from the negative electron: 'We can no more,' he says, 'have anything which can be called electricity apart from corpuscles than we can have momentum apart from moving matter.' A so-called negatively charged chemical atom is one having a surplus of electrons, the number depending on the valency, whilst a positive ion is one having a deficiency of electrons. Differences of electrical charge may thus be likened to debits and credits in one's banking account, the electrons acting as current coin of the realm. On this view only the electron exists; it is the atom of electricity, and the words positive and negative, signifying excess and defect of electrons, are only used for convenience of old-fashioned nomenclature.

The electron theory fits and luminously explains Ampère's idea that magnetism is due to a rotating current of electricity round each atom of iron; and following these definite views of the existence of free electrons, has arisen the electronic theory of matter. It is recognized that electrons have the one property which has been regarded as inseparable from matter—nay, almost impossible to separate from our conception of matter—I mean inertia. Now, in that remarkable paper of J. J. Thomson's published in 1881, he developed the idea of electric inertia (self-induction) as a reality due to a moving charge. The electron therefore appears only as apparent

mass by reason of its electrodynamic properties, and if we consider all forms of matter to be merely congeries of electrons, the inertia of matter would be explained without any material basis. On this view the electron would be the 'protyle' of 1886, whose different groupings cause the genesis of the elements.

There is one more property of the emanations of radium to bring before your notice. I have shown that the electrons produce phosphorescence of a sensitive screen of barium platinocyanide, and the positive ions of radium produce phosphorescence of a screen of zinc blende.

If a few minute grains of radium salt fall on the zinc sulphide screen the surface is immediately dotted with brilliant specks of green light. In a dark room, under a microscope with a two-third-inch objective, each luminous spot shows a dull center surrounded by a diffused luminous halo. Outside the halo the dark surface of the screen scintillates with sparks of light. No two flashes succeed on the same spot, but are scattered over the surface, coming and going instantaneously, no movement of translation being seen.

If a solid piece of a radium salt is brought near the screen, and the surface examined with a pocket lens magnifying about 20 diameters, scintillating spots are sparsely scattered over the surface. Bringing the radium nearer the screen the scintillations become more numerous and brighter, until when close together the flashes follow so quickly that the surface looks like a turbulent luminous sea. When the scintillating points are few there is no visible residual phosphorescence, and the successive sparks appear 'atoms of intensest light,' like stars on a black sky. What to the naked eye seems like a uniform 'milky way,' under the lens becomes a multitude of stellar points, flashing over the whole surface.

'Polonium' basic nitrate, actinium and radio-active platinum produce a similar effect on the screen, but the scintillations are fewer. In a vacuum the scintillations are as bright as in air, and being due to inter-atomic motion they are not affected by extremes of low temperature: in liquid hydrogen they are as brilliant as at the ordinary temperature.

A convenient way to show these scintillations is to fit the blende screen at the end of a brass tube with a speck of radium salt in front about a millimeter off, and to have a lens at the other end. I propose to call this little instrument the 'spinthariscope,' from the Greek word *σπινθαρίς*,* a scintillation.

It is difficult to estimate the number of flashes of light per second. With the radium about five centimeters off the screen the flashes are barely detectable, not more than one or two per second. As the distance of the radium diminishes, the flashes become more frequent, until at one or two centimeters, they are too numerous to count, although it is evident this is not of an order of magnitude inconceivably great.

Practically the whole of the luminosity on the blende screen, whether due to radium or 'polonium,' is occasioned by emanations which will not penetrate card. These are the emanations which cause the scintillations, and the reason why they are distinct on the blende and feeble on the platinocyanide screen, is that with the latter the sparks are seen on a luminous

* *Ἐνθ' ἐκ νηὸς ὄρουσεν ἄναξ ἑκάεργος Ἀπόλλων,*
ἀστέρι εἰδόμενος, μέσῳ ἤματι· τοῦ δ' ἀπὸ πολλαί
σπινθαρίδες πωτῶντο, σέλας δ' εἰς οὐρανὸν ἷκεν.

(Here from the ship leaped the far-darting Apollo, like a star at midday, while from him flitted scintillations of fire, and the brilliancy reached to heaven.) Homer's 'Hymen to Apollo,' lines 440–442.

ground of general phosphorescence which renders the eye less able to see the scintillations.

It is probable that in these phenomena we actually witness the bombardment of the screen by the positive ions hurled off by radium with a velocity of the order of that of light. Each particle is rendered apparent only by the enormous extent of lateral disturbance produced by its impact on the sensitive surface, just as individual drops of rain falling on a still pool are not seen as such, but by reason of the splash they make on impact, and the ripples and waves they produce in ever-widening circles.

Indulging in a 'scientific use of the imagination,' and pushing the hypothesis of the electronic constitution of matter to what I consider its logical limit, we may be, in fact, witnessing a spontaneous dissociation of radium—and we begin to doubt the permanent stability of matter. The chemical atom may be actually suffering a katabolic transformation; but at so slow a rate that supposing a million atoms fly off every second, it would take a century for weight to diminish by one milligram.

It must never be forgotten that theories are only useful so long as they admit of the harmonious correlation of facts into a reasonable system. Directly a fact refuses to be pigeon-holed and will not be explained on theoretic grounds, the theory must go, or it must be revised to admit the new fact. The nineteenth century saw the birth of new views of atoms, electricity and ether. Our views to-day of the constitution of matter may appear satisfactory to us, but how will it be at the close of the twentieth century? Are we not incessantly learning the lesson that our researches have only a provisional value? A hundred years hence shall we acquiesce in the resolution of the material universe into a swarm of rushing electrons?

This fatal quality of atomic dissociation appears to be universal and operates whenever we brush a piece of glass with silk; it works in the sunshine and raindrops, and in the lightnings and flame; it prevails in the waterfall and the stormy sea, and although the whole range of human experience is all too short to afford a parallax whereby the date of the extinction of matter can be calculated, protyle, the 'formless mist,' once again may reign supreme, and the hour hand of eternity will have completed one revolution.

WILLIAM CROOKES.

SCIENTIFIC BOOKS.

Index Animalium, sive index nominum quæ ab A. D. MDCCLVIII, generibus et speciebus animalium imposita sunt. By C. DAVIES SHERBORN. Part I., January, 1758, to December, 1800. Cambridge (England), University Press. (New York, Macmillan Co.) 1902. 8vo. Pp. lix + 1195.

All zoologists have been aware of the stupendous undertaking upon which Mr. Sherborn has been at work for the last twelve years, except for an interval during which his health was so impaired as to necessitate a temporary interruption.

The aim of the undertaking was 'to provide zoologists with a list of all the generic and specific names which have been applied by authors to animals since January 1, 1758,' together with an exact date for each page cited, and a reference 'sufficiently exact to be intelligible alike to the specialist and to the layman.' Special groups of animals have been so treated before, but this is the first work planned to include the entire animal kingdom in its scope.

Work was begun in July, 1890; in 1892 the British Association extended its support, and two years later appointed a committee to watch and advise the undertaking. Financial support has also been extended by the Royal Society and the Zoological Society of London.

In 1897, at the suggestion of Dr. Sclater, in view of the long period which must elapse before the completion of the whole manuscript, it was decided to publish that portion relating to the zoological literature of the eighteenth century, and this material drawn from some 1,300 volumes is comprised in the book now under review. When it is considered how rare many of the printed sources are, it must be considered fortunate that less than twenty titles comprise those which are still 'Libri desiderati.' Mr. Sherborn has been indefatigable in searching out obscure dates, the dates of works issued in parts, etc., and his contributions to our knowledge of the chronology of zoological literature will be gratefully appreciated by students.

There are one or two features of the scheme to which exception will undoubtedly be taken by many zoologists, such as the denial of standing to excerpts and authors' separates, which often appear years before the volume of transactions to which they belong is offered in its entirety to the public; also, the treatment of named figures as *nomina nuda*, if issued before or without a text explaining or describing them. However, if the facts and dates are fully included in the body of the bibliography, as we suppose to be the case, individual judgment can be exercised without reference to the views of the committee or compiler.

The list of works consulted covers forty-nine pages and is a most important part of the work, and we would strongly urge that in future instalments an even fuller and more explicit description of each be included, especially with regard to its relation to binomial nomenclature. What the student working out the nomenclature of a group needs is an exact statement of the facts. There will always be differences of opinion as to the use of these facts in some cases, but the judgment finally should be that of the student, and his opportunity to utilize the facts should not in any way be restricted by the views of those engaged in preparing or supervising the compilation.

Many of the works which are essential to the determination of questions of priority belong to the transition period when the Linnean system was not generally accepted and was frequently not even understood, so that it is of the first importance to the synonymist to know whether the author of such a work accepted the Linnean nomenclature or not, and, if he did not consistently accept it, the fact should be plainly stated. To cite an instance bearing on the question, a work by Moehring, 'Geschlachten d. Vogelen,' was printed in 1758. A friend, who, at my request, has consulted the only copy known to me in America, informs me that there are in the book no genera in the Linnean sense, no specific names in the modern sense whatever, only vernacular names; and the latest Linnean citation in the book is from the sixth (non-binomial) edition of Linnæus's 'Systema Naturæ.' The 'genera' of Moehring, therefore, are, like the 'genera' of Tournefort and other pre-Linnean authors, not entitled to be cited in systematic nomenclature. Yet of this in neither bibliography nor text of Mr. Sherborn do we find any intimation that Moehring's 'genera' are not regularly binomial.

Again, in the Museum Geversianum an extremely rare book with an important bearing on molluscan nomenclature, we find the majority of the animals cited under Linnean names, but the mollusks classified by a new method invented by Meuschen, all the 'generic' names being in the plural, many of them composed of two separated words.

'Genus 51' is 'Umbilici marini formes'; 'Genus 58' is 'Disci transfixi,' and so on. The former name does not appear in Mr. Sherborn's list at all, the second appears in the modified form of 'Disci-transfixus.' *Hippopodes* Meuschen, appears in Sherborn as *Hippopus,* without explanation, and the great majority of Meuschen's names are changed into forms which do not occur printed in his book at all. In his bibliography Mr. Sherborn states that "Meuschen's trinomials are his binomials plus 'forma' = 'varietas,' and are precisely similar to the trinomials used by mammalogists in the present day." I am not a 'mammalogist,' but I do not remember

ever seeing any mammalian generic names of the present day composed of three words or in the plural number. It is of course perfectly open to any one to accept Meuschen's polynomial plurals as 'genera,' if it seems good to them; the point here made is that a perfectly satisfactory bibliography should state the exact facts and leave the reader to apply them according to his own judgment.

Appreciating the immense and self-sacrificing labor devoted to this work by Mr. Sherborn and the committee, and the very great value to all working zoologists of the result; while feeling that any criticism must seem ungracious, we nevertheless believe that it is a matter of duty to insist on the importance of greater fulness in description and exactitude in citation of works in regard to which any doubt can exist. Otherwise an uncertainty which would be deplorable must rest on the published results, of such importance to every zoologist.

WM. H. DALL.

A Manual of Bacteriology. By ROBERT MUIR, M.A., M.D., F.R.C.P. (Edinburgh), Professor of Pathology, University of Glasgow, and JAMES RITCHIE, M.A., M.D., B.Sc., Reader in Pathology, University of Oxford. American edition (with additions), revised and edited from the third English edition by NORMAN MACLEOD HARRIS, M.B. (Toronto), Associate in Bacteriology, the Johns Hopkins University at Baltimore. New York, The Macmillan Company. 1903. 170 illustrations.

Every student of bacteriology is familiar with this excellent work of Muir and Ritchie, which must be regarded as one of the most comprehensive and most useful writings upon the subject, and every American student of bacteriology will welcome Dr. Harris's edition. In the preface of the American edition, Dr. Harris assures us that an endeavor has been made to add to the value of the book by giving practical expression of the best American laboratory methods and research, and at the same time to augment the general scope of the work without eliminating the personal impress of the author. Therefore, occasional alterations and additions of greater or lesser magnitude have been made throughout the book in general, but more especially in the chapters upon 'Methods of Cultivation of Bacteria,' 'Microscopic Methods—General Bacteriological Diagnosis—Inoculation of Animals,' 'Bacteria of the Air, Soil and Water—Antiseptics,' 'Typhoid Fever—Bacilli Allied to the Typhoid Bacillus' and 'Tetanus.'

Dr. Harris has so successfully introduced the added matter that it is practically impossible to differentiate his insertions from the original text, and we are pleased to observe that the original general arrangement and treatment of subjects has not been departed from. We are impressed with the care exercised by Dr. Harris in introducing new matter and bringing the book up to date, as well as by his selection of the important contributions of American writers to be introduced. We find the chapter upon 'The Methods of Cultivation of Bacteria' containing sufficient references to the work of Mr. Fuller upon 'The Standardization of Media' and the recommendations of the laboratory committee of the American Public Health Association upon the same subject. We also note with pleasure a description of Hill's 'Hanging Block Cultures,' by which the growth of bacteria upon solid media can be observed under the microscope. Stuart's 'Cover Glass Forceps' appear in the chapter upon 'Microscopic Methods.' Pitfield's method of staining flagella is considered with care. The chapter upon 'The Relation of Bacteria to Disease' has lost none of its excellency, though this chapter has always been of such a superior quality that it would be hard to find any way to improve it. Throughout the special part of the work we notice that matters of recent controversial interest are carefully, though not dogmatically, treated. The various toxic products of bacteria are mentioned in brief, commonly with the conclusion that very little is known about them, so that the student is not led astray. Likewise the importance of antitoxins and antiserums in those diseases in which their virtue is not proved, are but briefly dwelt upon. Koch's suggestion that the bovine tubercle bacillus does not infect man is discussed and Theobald Smith's pre-

vious contribution upon the subject mentioned. The matter is dismissed with the statement, 'As at present the subject is still under investigation in this and other countries, it would not be justifiable to dogmatize, but in the meantime we see no sufficient reason to depart from the view entertained up to this time, that the tubercle bacilli infecting mammals are of one and the same species, though differences in virulences obtained, and that milk containing tubercle bacilli is a highly important source of infection to the human subject.'

The other 'acid-fast' bacilli are mentioned briefly without speculation as to the probable ancestral importance of the grass bacilli of Moeller, to the smegma bacillus, lepra bacillus, tubercle bacillus and others. The chief use of tuberculin is said to be the diagnosis of tuberculosis in cattle. Concerning the new tuberculin, it is said 'Little success has attended the use of this substance as a remedial agent.' It is said that attempts to grow the leprosy bacilli outside of the body have so far been unsuccessful. Evidently the editor does not accept the recent contributions to the subject. The bacillus of rhinoscleroma is said not to stain by Gram's method.

The chapter upon 'Typhoid Fever' is excellent and the treatment of the colon bacillus unusually good. The author points out that the mere presence of the colon bacillus in water is not necessarily indicative of sewage pollution, as this organism is so widely distributed in nature. He also shows that the presence of the *Streptococcus* and *Bacillus enteriditis sporogenes* are important adjuncts in the detection of sewage. The microorganismal differences between fresh and stale sewage are also dwelt upon. Considerable attention is devoted to bacillary dysentery, the recent work of Flexner being given sufficient prominence. In the chapter upon 'Diphtheria' Dr. Harris seems doubtful whether the bacillus of Hoffman is an attenuated form of the diphtheria bacillus or a separate species, though he says: 'The possibility of the transformation of the pseudo-diphtheria (Hoffmann's) into the true diphtheria bacillus has been the subject of much controversy, but it can not be regarded as sufficiently established that such a transformation may be effected, still less that the former organism is related to the origin and spread of diphtheria.' We heartily endorse Dr. Harris's view that it might be well, when practicable, that every ragged unhealthy-looking wound, especially when contaminated with soil, should, as a matter of routine, be examined bacteriologically. Under such treatment from time to time cases of tetanus would be detected earlier and their treatment could be undertaken with more hope of success than at the present time. We have, however, not infrequently made very careful bacteriological studies of wounds, shortly afterwards followed by tetanus, in which for unknown reasons we failed to find any bacilli, and we regret that Dr. Harris does not recommend that simultaneously with this bacteriological examination a prophylactic injection of the antitoxic serum be given. We are fully convinced that by routine use of the antitetanic serum for purposes of prophylaxis many useful lives might be saved. We regret that in the chapter on yellow fever the name of Dr. Carlos Finlay does not appear. It was Dr. Finlay who originated the mosquito theory. The United States Army Commission of 1900 and 1901 simply proved it to be correct.

The chapter upon 'Immunity' is excellent, though we do not regard the space devoted to the 'lateral chain theory' of Ehrlich as sufficient, considering its importance and wide usefulness, and we also regret that no diagrammatic representation of Ehrlich's views is given. The usefulness of the book is augmented by excellent though brief chapters upon such other microparasites as molds, yeasts, the malarial organisms and the ameba coli. At the end of the volume eighteen pages of bibliography are appended in which a great deal of very useful material is stored away in such form that we doubt whether it will ever be utilized by students. There seems to be no systematic mode of reference to the literature given, and our impression is that references in the text to footnotes at the bottom of the page or to literature given at the end of each chapter is a far more useful

method of introducing bibliography into text-books. JOSEPH MCFARLAND.

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SOCIETIES AND ACADEMIES.

ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of June 1, 1903, Drs. B. M. Bolton and D. L. Harris exhibited sections cut after infiltration with agar-agar, and described the use of this material for embedding purposes as follows:

Tissues can be readily hardened and embedded for cutting into sections in a hot solution of agar-agar containing formalin. The proportions of the mixture which have so far yielded the best results are nine parts of a five per cent. aqueous solution of agar-agar to one part formalin. This mixture can be prepared beforehand and kept indefinitely in an air-tight vessel. The agar-agar should be boiled for several hours, and after the addition of the formalin allowed to clear by sedimentation. The bits of tissue to be embedded are placed in a wide test-tube or wide-mouth vial containing the mixture previously melted. This is kept at 65–70° C. for an hour or longer, and the tissues are ready to be blocked. After attaching to blocks they are placed in strong or absolute alcohol for an hour or two and can then be cut. It is important not to use dilute alcohol. The tissues are stuck to the blocks by means of the agar-agar itself and adhere as soon as the agar becomes cold. No previous hardening of the tissues is at all necessary; fresh tissues can be placed at once into the hot agar-agar-formalin mixture; in fact, fresh tissue is more desirable than that which has been previously hardened, though this can also be readily embedded by this method. But the main advantage of the method, aside from its convenience and simplicity, is the fact that the cells of the tissues are not at all contracted or shrunken, and the ordinary methods of hardening have this effect more or less. With sections prepared from fresh tissues by this method the cell-protoplasm fills out the membrane fully, and the granules of the protoplasm, the nuclei, and the cell contours are remarkably distinct. The whole process, hardening, embedding and cutting, does not occupy more than three or four hours, where the tissues are not larger than about one centimeter in diameter.

Professor A. W. Greely presented the results of an investigation of the relations of *Paramœcia* and other protozoa to chemical and electrical stimuli. A detailed account of this investigation has been contributed to SCIENCE.

WM. TRELEASE,
Recording Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 143d meeting of the society, held in the assembly hall of the Cosmos Club, Wednesday evening, April 22, 1903, a general discussion on the problem of the occurrence and storage of crude petroleum and petroleum products was opened by Dr. David T. Day in a paper entitled 'Experiments on the Diffusion of Crude Petroleum through Fuller's Earth.'

Dr. Day reviewed a series of experiments which he has been carrying on intermittently within the last five years on the changes which take place in crude oils by diffusion through various porous substances.

It was found that if crude petroleum were allowed to pass slowly through finely pulverized fuller's earth, it became separated by fractional diffusion into a series of oils differing in color and specific gravity from the original product, and representing the comparatively simple oils of which the complex crude petroleum is composed. In color the fractions varied from the dark brown or amber of the crude to the clear white of refined petroleum, and variations in specific gravity from .70 to .85 were secured.

An account was given of a series of experiments conducted by Professor Engler, to determine the nature of the changes which took place in the oil. Professor Engler's conclusion was that no chemical change whatever took place in the process of diffusion, the differences in the resulting products being entirely physical.

Experiments as to the effectiveness of various diffusion media tended to prove that the best results are invariably attained by the use

of fuller's earth. Quartz sand and amorphous silica exhibit practically no selective action. Powdered limestone was equally ineffective. Different clays show greatly differing capacity for separating the petroleum oils, the greatest effectiveness being secured as the clay approaches fuller's earth in composition and texture.

Interesting practical and scientific suggestions made by Dr. Day as a result of his experiments were, first, that the great variety in color, specific gravity, viscosity, etc., of the different Pennsylvania oils may be due to differences in amount of diffusion suffered by these oils in passing upward through Carboniferous shales from a common source, rather than to differences in original composition; and a corollary of this suggestion is that these oils and those of the Trenton district in western Ohio may have an identical original source far down in the geologic column, the present differences being due to the greater diffusion suffered by the Pennsylvania oils in passing upward through the intervening strata to the horizons in which they are now found.

An examination of the Texas oils shows that they contain considerable amounts of constituents which are most easily removed by diffusion, the conclusion being, therefore, that they are nearer the original source than the Ohio and Pennsylvania oils.

At the conclusion of Dr. Day's paper a number of geologists, among them Messrs. Hill, Eldridge, Hayes, Adams, Butts and Fuller, discussed various phases of the problem of the origin and storage of the fluid and gaseous hydrocarbons, the suggestions of Dr. Day as to the competency of fractional distillation by diffusion to account for the present differences in native oils, and the further suggestions of a common origin for many of them being regarded as of particular interest.

W. C. Mendenhall,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE PROPOSED BIOLOGICAL LABORATORY AT THE TORTUGAS.

To the Editor of Science: Since the subject of a research laboratory in or near the tropics is under discussion, I would like to have the privilege of a few comments. For the last two years I have been discussing the matter privately with a number of people who are interested in establishing a subtropical biological laboratory. This is by no means new, since an attempt was made a few years ago to carry on research work at Bimini, an island about fifty miles east of Miami. At another time the question of locating a laboratory at Miami was under discussion, and my department (biology) at the Florida Agricultural College pledged a small sum to aid in the expense of carrying on this work.

The advantages of establishing such a laboratory at Miami may be stated as follows: (1) Miami is about one degree of latitude south of the northern limits of the Antillean flora. (2) The city is located on the Biscayne Bay, a magnificent sheet of water that is always navigable to sail-boats and launches. (3) The Gulf Stream is within easy reach, being only about six or seven miles out, cat-boats and launches making one or two trips a day during the tourist season. (4) The Miami River, Little River and other streams, which drain the everglades, may be explored easily for fresh-water forms. (5) The everglades can be reached by row-boat or bicycle, macadamized roads having been built to the edge of the glades. This vast unexplored region, about which so many erroneous ideas are abroad, is now open for botanical exploration. (6) Miami is within twenty-four hours of Havana and twelve hours of Key West by steamer. Washington can be reached in thirty-six hours. (7) Launches and sail-boats may be chartered at any time at reasonable rates. (8) Miami is located south of the 26th degree of north latitude.

At the present time the tropical laboratory has only one room which can be offered to visiting biologists. This has been in almost constant use during the past year. Among those who have taken advantage of this opportunity are Professors V. M. Spalding and J. H. Comstock.

There can be no doubt as to the healthfulness of the location, and the comforts of life

are abundantly supplied. The city has a population of about 4,000, and has water works, sewer system and electric lights. There are over forty miles of macadamized roads in the best of condition for wheeling. The question of mosquitoes has been raised by one of the people discussing this matter. There are certain places in the state of Florida that are seriously infested, but at the location under discussion there is very little difficulty. The hommocks and mangrove swamps will prove to be thickly infested during the summer months, but in the clearings and on the pine land the mosquitoes are certainly not more annoying than in Iowa or Minnesota.

In a recent number of SCIENCE, one of the correspondents discusses the question of locating the laboratory in Jamaica. The location may be an ideal one from several points of view; it is, however, an out-of-the-way place, and one difficult to get to and get away from. There are practically only three lines of steamers which permit one to visit the island comfortably. These sail from Boston, New York and Philadelphia. To reach the island it would be necessary to sail from one of these ports. The average worker would lose nearly a week in getting to the laboratory. To attempt to make the trip by way of Havana and Santiago requires nearly three weeks, together with a very heavy expense account. The fact of traveling in a foreign country has some fascination about it, but has likewise its disadvantages for scientific research. We have on our southern coast a vast unexplored region which has been given only a cursory examination.

Dry Tortugas has also been under discussion. This seems to be an ideal place for solitary confinement, as one of our correspondents points out. This is all right for about six or eight hours a day, but during the other sixteen or eighteen hours it is very pleasant to have the companionship of people. Dry Tortugas would have to be reached by way of Key West. It being about sixty miles west of Key West, one would have to charter a sail-boat or a launch and pay for at least two days to make the trip, a considerable loss of time.

The majority of people who work in these research laboratories have only two or three months to put in at one time, and it becomes very important, therefore, that they should not spend twenty-five per cent. or more of this time in going to and returning from the laboratory. A laboratory located at a railway station would prove much more convenient, even if located in a field not so rich as one that would be located at a point which requires a considerable amount of traveling to be reached.

P. H. ROLFS.

U. S. DEPARTMENT OF AGRICULTURE,
TROPICAL LABORATORY, MIAMI, FLA.

TO THE EDITOR OF SCIENCE: I have read with interest the letters in SCIENCE relating to the establishment of a biological station at the Tortugas, also Professor MacBride's suggestion favoring the Bahamas and Professor Duerden's favoring Jamaica.

Will you kindly allow me to make one further suggestion? I would ask that the Isle of Pines be considered as a location for this station and for these reasons:

1. As Professor MacBride says, West Indian waters 'surpass in interest and variety of species the Mediterranean.' The fringing ceyos, bays and rivers of the Isle of Pines give areas of water at varying depths and, it seems to me, conditions unsurpassed for collecting the greatest variety of species.

2. This island, though in the tropics has, because of sea breezes, a climate agreeable for study the year round. The dry, buoyant air prevents one feeling the languor usually experienced in the tropics.

3. The fresh water supply at the Isle of Pines is unsurpassed. The fertile gardens can supply food, and lumber and building material are abundant.

4. The climate is most healthful, there being no epidemic sickness. Yellow fever, typhoid fever and malaria are unknown. Americans can live there for years in excellent health.

5. This island belongs to the United States, and it is probable that a naval coaling station is to be located there. It is easy of access.

Students then could, on the Isle of Pines, have a delightful place of residence, with all

the requisites of health and comfort and variety of scenery and exercise, while perhaps no other place could supply a greater abundance of the material for study, both marine and terrestrial.

Of course I am unable to give an opinion of value on this subject. I only ask an investigation of this Island of Pines.

J. Fred. Clarke.

'MOUNT PELEE.'

To the Editor of Science: In Science for June 5 Mr. Mark S. W. Jefferson raises a question which is of interest to those who, like myself, are studying the volcanoes of the West Indies: What shall we call the now celebrated volcano on the island of Martinique? Mr. Jefferson seems to be inclined to use the name 'Mount Pelee.'

During a stay of four weeks on the island last year and another visit of like duration this year, I heard the mountain called almost invariably 'Mont Pelé,' very rarely if at all 'La montagne Pelée.' The latter form is that employed on the charts of the island, but the former is the one most commonly used by the French in correspondence and in written descriptions, as well as in conversation, as being more compact. The general tendency among geographers now is toward using geographical names in the way in which they are employed in the region containing the geographical feature, hence it seems to me better to write the correct French 'Mont Pelé,' than the Anglicized 'Mount Pelee,' in which there is little suggestion of the true pronunciation of the name. When but one word is to be used for the mountain, the generally accepted form, 'Pelée' is convenient and is to be recommended as conforming the formal appellation of the volcano. I speak with the more feeling on this topic, because I am one of those who have helped to perpetuate the incorrect combination, 'Mt. Pelée.'

Regarding the origin of the name and its applicability to the mountain it may be remarked that the accepted explanation among Martiniquans is that the term has been derived from the ancient Carib name for the mountain. When Columbus discovered Martinique he found a Carib town at Le Carbet, nearly two miles south of the present site of St. Pierre. The Caribs were afraid to live any nearer to the volcano on account of their traditions regarding its activity; and they called it the 'bald' or treeless mountain, a name which in itself indicates traditional eruptions. Any one who has seen Mont Pelé since May 8, 1902, will grant that the mountain now merits its name.

Edmund Otis Hovey.

SHORTER ARTICLES.

ON THE LIMITS OF UNAIDED VISION.

It is generally accepted that the sixth stellar magnitude is the limit of naked-eye vison. Though observers with eyes of unusual sharpness may under favorable conditions see stars nearly an entire magnitude fainter, that this is for all practical purposes the limit may be seen from a consideration of the faintest stars given in the various star catalogues and uranometriæ devoted to naked-eye stars. The average magnitude on the scale of the Harvard photometry of the faintest stars visible in several of these catalogues is as follows (*H. C. O. Annals,* Vol. XIV., Part II.):

Ptolemy's Almagest	5.38 M.
Sûfi	5.64 "
Argelander, Uranometria Nova	5.74 "
Heis, Atlas Cœlestis Novus	6.06 "
Houzeau, Uranométrie Générale	6.40 "
Gould, Uranometria Argentina	6.71 "

Argelander states that his sixth magnitude comprised stars as faint as he could make out at Bonn; his eye, according to his own estimate, was of moderate sharpness. The faintest class of Houzeau comprised those stars which, under favorable conditions, could not be seen continuously, but only at intervals. Gould found in the clear atmosphere of Cordoba that on very good nights observers of ordinary vision might go even below his seventh magnitude (6.71 M. Harvard phot.), and attributes it mainly to the advantage given by the altitude of the observatory. Several of the observers at the Lick Observatory have, under the most favorable condi-

tions, seen stars well down toward the seventh magnitude.

The invisibility of stars of the seventh magnitude or slightly fainter is due mainly to the amount of light given by the background of the sky, even on the clearest nights and in regions well removed from the Milky Way (*cf.* papers by Professor Simon Newcomb, *Astroph. Jour.*, December, 1901; Dr. S. D. Townley, *Pub. A. S. P.*, No. 88, and G. J. Burns, *Astroph. Jour.*, October, 1902). At Professor Newcomb's suggestion Director Campbell has asked me to find my own limit of naked-eye vision, having given as artificial aids the direction of the star, and the screening off of the light of the sky.

Two blackened screens were attached to the twelve-inch telescope at a distance apart of 178 inches. The rear screen was pierced with an aperture half an inch in diameter and that at the object glass with one of one quarter of an inch. These apertures were so aligned that when a star was seen centrally through them it would be found at the intersection of the cross-wires of the three-inch finder. A movement of two or three minutes of arc was sufficient to carry the star out of the field thus formed.

The method of observation adopted was to clamp the telescope at the proper declination for the selected star. It was then swept slowly in right ascension with the eye at the aperture till the star was picked up. The position of the star was then noted in the finder and if not more than a minute or two of arc from the intersection of the cross-wires the observation was considered successful. Several such trials were made on each star.

Eleven stars were observed on three nights, of which only the last could be called a very clear night. The magnitudes of the stars employed ranged from 6.42 to 8.5. It was found that up to and including magnitude 8.0 the stars could be certainly seen in every instance, though in no sense easy objects. Stars of magnitudes 8.1, 8.2, 8.3 and 8.5 were seen with great difficulty and with occasional failures, generally when the eye was tired from the strain of searching for these very faint objects.

The contrast between the almost perfect darkness of the object glass screen and the sky immediately around it, as seen through the rear aperture, was very marked. It seems evident that for the observation of such faint objects without telescopic aid the screening off of the light of the sky is more important than the concentration of the vision in a definite direction as afforded by the use of the apertures.

HEBER D. CURTIS.

LICK OBSERVATORY,
April 22, 1903.

A MODIFICATION IN MEASURING CRANIAL CAPACITY.

ONE of the most important, but at the same time rather difficult and tiresome, manipulations in anthropometry is the measuring of cranial capacity. The importance of the measurement lies mainly in that it gives us the volume, as well as a fair basis for the calculation of the weight, of the brain, both of which data are very valuable in racial comparison, and, so far as most of the more primitive races of people are concerned, are quite impossible to be secured in any other manner.

It is plain that a procedure of such importance should be brought to the utmost possible simplicity and perfection, and so regulated that the capacity measurements could be utilized with full safety and universally. This sentiment was undoubtedly common to all the practical workers in physical anthropology up to the present day, and the results have been an invention of many more or less related methods for measuring cranial capacity, and a gradual approach to an ultimate, generally adoptable, procedure, under the circumstances the nearest possible to perfection. It is in connection with this very desirable, ultimate method, the main points of which are already well understood, that there is still a place for some modification, and one such will be described in this paper. In the first place, however, it is advisable to give a few explanatory notes as to the various procedures in general use.

The many methods of measuring cranial

capacity can be segregated into five groups, namely:

1. The skull is made impermeable and then filled with some liquid, preferably water, which is then weighed or measured; or the water is forced into a thin rubber bag until it fills with this the entire skull cavity, after which the liquid is measured. These methods, employed by Broca, Schmidt, Matthews, etc., yield good results, but are too complicated or tedious for ordinary use.

2. The skull is filled with sand or other substances, and this is weighed, the result giving a basis for calculating the capacity. This method, used especially by some American anthropologists of the last century, was not sufficiently accurate, and soon became obsolete.

3. The skull is filled with small, rounded seeds, beads, shot or other substance, and the contents are then measured (Tiedemann, Busk, Flower, etc.). The filling or the measuring (or both) is aided by certain manipulations (tilting, tapping, etc.), but, except the measuring vessels, no implements are required. The method in its numerous modifications is comparatively easy and has other advantages, but the results are mostly not as accurate as desirable.

4. The method invented and regulated by and named after Broca. In this procedure the skull is packed with shot, which is then measured; but both the filling and measuring are aided by certain implements, and every step of the procedure follows definite rules. Among the implements used appears a funnel of certain dimensions, which controls the flow of the shot. The method gives steady results, but can not be used with frail skulls, and the capacity obtained is always larger than actual, the proportion growing with the size of the skull.

3. The Welcker's method.* In this procedure, which is the outgrowth of the majority of those mentioned, but more directly of that of Broca, the most important part is delegated to the funnel, which, by its size, controls the measuring of the contents of the skull. The mode of filling the skull, so long as efficient and uniform, is immaterial; all that is required is that each worker should, with the aid of a standard skull, find the exact size of the funnel necessary to give him, in measuring, the correct result with his particular method and substance used for the filling of the skull. Any rounded seed or substance can be employed for the filling, as it is possible to completely fill the cranial cavity without using the process of jamming, such as that used by Broca; this allows the most fragile skull to be measured without any injury. Welcker advocated a funnel large enough to receive all the contents of the skull. The contents of the properly filled skull are emptied into a separate vessel and then 'with one movement is versed into the funnel,' which is open (not provided with any stopper) and held in position vertically and centrally above the graduated receiving vessel. Each new series of measurements is controlled by the standard skull.

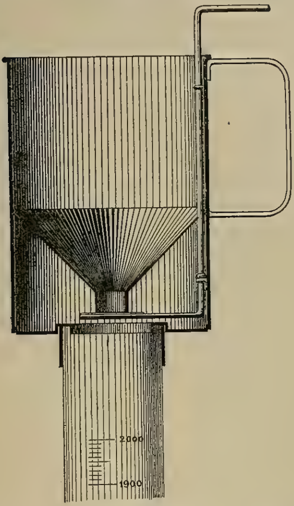
There can be no doubt that this last is the most advanced and preferable method, and the one which, a little more perfected, presents the best claim for universal adoption.

Experimenting for nearly six years, at the American Museum of Natural History, with the various earlier procedures of measuring cranial capacity, I arrived, a little over two years ago and practically independently, at a method which in principle is identical with that of Welcker, but is carried on with a few further helping details which deserve being mentioned.

Starting, as Welcker, with the laws concerning the flow of solid substances, etc., as laid down by Broca, and with Broca's implements and a standard skull, I was soon able to satisfy myself that: (*a*) The same substance poured through the same funnel with the same rapidity will always give the same, but with different rapidity will give differing, measures; and that (*b*) each different substance that can be utilized for the measurement of cranial ca-

* *Arch. f. Anthrop.*, Bd. XVI., S. 1 et seq. E. Schmidt, 'Anthropologische Methoden,' pp. 217–219. Recently a modification of the instruments with a form of a funnel stopper has been proposed by E. Landau, *Intern. Centralblatt f. Anthrop.*, etc., 1903, I., pp. 3–7.

pacity, flowing through a definite size funnel and with regulated rapidity, will give different results from those given by any other substance flowing through the same funnel and with equally regulated rapidity. (c) Given the same regulation of rapidity of the flow, there can be obtained, through the proper selection of funnels of different diameter, any measurement, ranging between the minimum and maximum of a substance of medium weight and size, by all the solid substances employable for filling the cranial cavity.



Without going into details, I may state that I obtained a very efficient regulation of the flow by adding to the funnel a movable stopper.* By doing this I found by many practical demonstrations that it becomes immaterial as to with what rapidity, or in what manner, the funnel is filled before opening the stopper. This removes at once all source of error connected with the emptying of the cranial contents, and allows us to dispense with the extra vessel used in measuring the cranial contents in Welcker's procedure. With the funnel closed, the cranial contents are poured into it entirely at the convenience of the measurer.

In 1901 I had constructed, mainly on the basis of Broca's, a special apparatus, of which a cut is inserted, and with this I have worked since with much ease and with entire satisfaction. My favorite mode of filling the skull is that used by Flower. To measure the contents, they are emptied directly, in any way desired, into a combination of a zinc vessel (higher than, but otherwise similar to, the standard Broca's double litre) and a removable funnel of 45° dip, with 15 mm. high vertical section, which, for my purpose (using old, dry mustard seed), is 20 mm. in diameter. Immediately below the funnel is a movable disk which acts as its stopper. The disk is attached to a rod which rises along the side of the vessel and above its border, and ends in a lever; by using this lever the disk closes or opens the funnel. A number of extra funnels, of the same dip but of different sizes, are provided, from which to choose if another substance than mustard seed is used for the filling. The vessel with the cranial contents is placed on the top of a 2,000-c.c. graduated glass tube (such as used by Ranke), which is fixed in a vertical position. The zinc vessel is provided with a groove in its bottom which exactly fits the border of the glass, the opening of the funnel being central. Then the lever is rapidly pushed to either side, opening the funnel at once and completely, and the flow left to itself; the level which the seed reaches (determined simply by the eye or, preferably, by the careful aid, without any shocks or pressure, of a niveau finder, such as comes with Ranke's tube) is the skull capacity. Thus the measuring part of the capacity determination is entirely reduced to a mechanical one, which not only makes it very easy, but eliminates from it all source of error due to personal equation. All that a student needs to learn is some method by which a complete and uniform filling of the skull can be effected, and then, working with the aid of the standard skull, choose the proper funnel; the rest is

* Landau's stopper differs in kind, but is apparently allied in purpose.

controlled. The results, always with the condition that the proper use is made of the standard skull, are as uniform and as near the reality as can be reasonably hoped for.

The apparatus I use is not made for the market, but it should not be difficult for any one sufficiently interested to have it constructed, following the given directions.

ALĚS HRDLICKA.

U. S. NATIONAL MUSEUM.

NEW DEPARTURES IN THE CONCILIUM BIBLIOGRAPHICUM. II.—THE SUPPLEMENTARY BIBLIOGRAPHY.

THIS portion of the great catalogue exists primarily in manuscript form. As fast, however, as the demand for any part becomes great enough the cards are duplicated by a new lithographic process. Should the demand become still greater, typography would be resorted to. This ought certainly to be the case for the American section.

The references consist of such entries as can not for practical reasons be admitted into the general bibliography. The price of any given collection of cards is double that charged for the same number of cards taken from the main bibliography, ranging thus from half a cent to two cents a card.

1. *New Genera, Species, Subspecies, etc.*—As was shown in the first part of the present article, the Concilium adopted several years ago the uniform practice of reading, or at least perusing, the text of every publication entered in the bibliography. In this way the descriptions of all families, subfamilies, genera, subgenera, species, subspecies, etc., described in zoology passed before our eyes. It seemed under such circumstances a great pity that the information thus acquired should not be placed at the service of the zoological world. A beginning was made by referring to every new species under the appropriate genus name in connection with the printed cards. This has been made a permanent feature of the card catalogue, and no card is now issued which does not bring references to all new species described and to all new names introduced by the author. Many zoological memoirs contain descriptions of several hundred new species; but we have never wavered in our decision to record everything, even though double and triple cards were required.

The value of these entries is very great; but we have, of course, not been able to cite every species in full, nor to state the locality from which it came. Nor were the printed cards giving references to the new species available for an adequate catalogue of new species; for, in most cases, species from many different genera being described in a single publication these were recorded on a single card. In 1900 certain preliminary experiments were made in view of testing the possibility of placing all novelties on permanent record, so that, for example, a zoologist turning to the genus *Carabus* in the year 1950 might find before him in convenient form an exhaustive catalogue of every new subgenus, species and of every new name introduced under that genus since 1901. The value of such a record seemed to us quite inestimable and one can well imagine the feverish impatience with which the outcome of our experiments were awaited, for they were to decide whether this gigantic task lay within the possibilities of our organization. The experiments showed that the labor would in truth be immense. We also had to face the stubborn fact that we were working for posterity and that the full value of the work would not be appreciated for many years. We also knew that the entire work would be a complete financial loss. In view of all these facts it was, indeed, a bold decision which we took on January 1, 1901, when we began recording each novelty on a special card. The work is now progressing well, and if the Concilium be adequately supported, will never be abandoned.

The collection of references to such a genus as *Carabus* will not be the only facility which the Concilium will offer to the student coming to it in 1950. If a person is then desirous of studying the fauna of Bolivia, my successor in office will first show him the main printed bibliography, comprising at that date some 200 to 300 entries; he will then lead the visitor to a great cabinet of 72 drawers devoted to the new species described from South Amer-

ica. At the present rate of publication, three library bureau drawers would, fifty years hence, be devoted to Bolivia. The 2,500 cards would not, however, be indiscriminately arranged. One drawer would be devoted to arthropods. The greater part of the drawer would be filled with references to the insects, readily recognizable by the appropriate symbol of the decimal classification. A rather large group of cards would follow the guide card Coleoptera. Relatively smaller packets would refer to the primary subdivisions of the Coleoptera. I do not seriously believe that a representative of the genus *Carabus* will have appeared in Bolivia; but I trust that the references to Felsche's species of *Pinotus* will still meet the eye of the visitor of 1950 and that he will respect the self-sacrifice that made the inauguration of the work possible.

Multiple entry is the feature of the catalogue of new species as of the printed bibliography. Thus, in the paleontological part, there is not merely a division for dinosaurs, there is also an exhaustive treatment of the fossil fauna of Kansas gathered together under the heading Kansas, and a reference to all discoveries of Cretaceous animals under the appropriate stratigraphic heading.

Most of the work that we are here undertaking has never been attempted before; but our experience has shown that, in such places as our activity runs parallel to other recording agencies, we find in the latter so numerous omissions that the necessity of a more perfect organization of the work is most apparent. Even in regard to genera, a cursory comparison showed omissions aggregating a hundred or more, while, in regard to species and subspecies, we are sure that many hundred are recorded in the catalogue of the Concilium which are elsewhere quite overlooked. Omissions, of course, occur in our lists, but, again, we know just where the gaps lie and can make them good as soon as we can obtain access to each publication which we had not hitherto been able to excerpt.

The two years' experience has shown us, furthermore, how impossible it is for the individual worker to avoid giving preoccupied names. As soon as we detect such errors we inform the author and suggest a change. Often the same name is chosen by two authors within a few weeks of each other, so that the entry in our record with date is highly important. In regard to genera the case is most disturbing. How can an ornithologist describing a new genus of birds be sure that his name has not been used by some paleontologist describing a fossil sponge? No such universal knowledge of the literature can be expected of any worker. For this reason, the Concilium is anxious to issue at frequent intervals, perhaps yearly, with cumulative five-year and twenty-five-year indexes, a cheap concise list of genus names that have been proposed. This work would supplement the 'Nomenclators' of Agassiz, Marshall and Scudder and the work recently published by the Zoological Society of London.

The following entry may serve to illustrate the arrangement of the text of our record of new species:

57.98 Nesodynerus (96.9)
obtabilis n. sp.
Perkins 1901*a*.
Entom. Monthly Mag. (2), Vol. 12, p. 267.

57.98 is the group number for Vespidæ, (96.9) for Hawaii. A second entry is made under (96.9) as primary division.

2. *Minor Notes.*—Many local journals of natural history, *e. g., Entomologist, Auk,* etc., publish, often in small print, numerous notes on captures, isolated observations of habits, records of trifling color variations and so forth. Ever since the foundation of the Concilium it has been a burning problem how to deal with these notes. It is out of the question to neglect them, for they may contain changes of nomenclature which by the rule of priority might become decisive of the proper name of an animal. Thus we may find new genera of fishes actually introduced for the first time in the editorial talks on recent literature appearing in the *American Naturalist!* No form of publication can be too trivial for a conscientious bibliographer, so long as the law of absolute priority forms the basis of our nomenclature.

In regard to these minor notes, the bibliographies in pamphlet form have a vast ad-

vantage over a card bibliography. No one need hesitate long to sacrifice two lines of print even to an almost worthless publication. But when it is a case of publishing a complete bibliographical card it becomes a most serious matter. For many years the Concilium tried various subterfuges; it issued many cards that seemed scarcely worthy of notice; it then experimented with printing the references on gummed paper to be pasted on cards by the subscriber, if desired. It also tried holding back such references till the end of the year and then publishing a dozen or more entries on a single card.

None of these means was successful. Finally, in 1902, a great catalogue of manuscript entries was founded. Such entries being omitted from the printed bibliography, the total number of cards sent to subscribers will be reduced annually by a thousand or more. The new cards are similar to the ordinary bibliographical cards in every respect, save that instead of being printed they are in manuscript. They can, however, be supplied when desired. Thus a subscriber in California will not be burdened by innumerable tales of beetles found in the county of Kent, England. For the inhabitant of Kent the note may have value, for the Californian it is rather superfluous. In future the Kent entomologists can receive the reference if they care for it; but the Californian ornithologist need not. This new departure means a loss to the Concilium of several hundred dollars annually. The maintenance of the manuscript catalogue is costly and the income from the printed card catalogue is reduced by leaving out such notes. It is merely a case of what I may conscientiously declare to have been the uniform policy of the Concilium, that of never deviating a particle from its disinterested aims. Every innovation of recent years has been attended with financial loss; but never have we faltered in assuming it. We have perhaps often imperiled the very existence of the work by such scruples, but at the same time we have, I believe, won the unqualified approval of every one who has taken the pains to examine closely our work and can with justice appeal for support to those who have the interests of science at heart. I am confident that the disaster which the abandonment of the work would entail is not a danger which is seriously threatened. The immediate needs of the institute seem to us great; but they are only so in comparison with the modest means which have thus far succeeded in keeping the enterprise alive. A debt of $4,000 ought not to burden indefinitely the work. $3,500 for new machinery ought not to be a hopelessly large sum to secure. A yearly grant from an American source equal to that offered by little Switzerland ($1,500) seems least of all exaggerated. And yet this is all that is needed to inaugurate a period of prosperity and work without preoccupations of a financial character. Doubtless new possibilities and new needs would open as the years passed; but the present program could be fully carried out with the support that I have sketched.

Herbert Haviland Field.

REPORT OF THE ICHTHYOLOGICAL RESEARCH COMMITTEE.*

We understand that the committee appointed by the Board of Trade in August last year 'to inquire and report as to the best means by which the State or local authorities can assist scientific research as applied to problems affecting the fisheries of Great Britain and Ireland, and, in particular, whether the object in view would be best attained by the creation of one central body or department acting for England, Scotland, and Ireland, or by means of separate departments or agencies in each of the three countries,' have come to the conclusion that, while no sufficient reason has been adduced for suggesting any changes as to the central authority for conducting scientific fishery investigations in Scotland and Ireland, it is desirable that the functions of the Fisheries and Harbor Department of the Board of Trade, which is the central authority for England, should be considerably enlarged. They recommend, therefore, that the Board of Trade should have power not only to delegate to any satisfactory fishery authority the conduct of such fishery

* From the London *Times*.

investigations as the latter body are willing and able to carry out, but also themselves to conduct investigations; and, further, that the local fishery authorities and the authorities or bodies who conduct or contribute to the expenses of such investigations should be represented on a Central Fishery Council at the Board of Trade, which council should have general control over all such investigations.

To give practical effect to this scheme the committee recommends the constitution at the Board of Trade of a Fishery Council for England, consisting of one expert and one administrative member representing each of the three coasts (E., S., and W.), together with such official representative or representatives as the department may nominate; the duty of this council being to meet periodically, to formulate schemes of investigation, to make recommendations as regards Governments grants, to report on the knowledge acquired by the researches made, and, generally, to exercise control over the investigations. In order to secure uniformity of action between scientific bodies at work in the seas surrounding the United Kingdom, and to prevent overlapping of areas of research, the committee suggest that there should be a conference consisting of representatives of the three central authorities to this extent only. The committee propose that statutory powers should be given to the local sea fisheries committees to expend money on fishery research; and, recognizing that on the east coast of England (except to a small extent in Northumberland) there are no local fisheries committees contributing to the knowledge of fishery problems, they recommend that the Fishery Council for England should itself conduct investigations on that coast. The committee think, however, that, if possible, the expenses of such investigations should be partly borne by those who are pecuniarily interested in them.

Another point emphasized in the report is the desirability of making provision at the principal fishing ports of the United Kingdom for the collection of statistics on the largest scale practicable for the purpose of ascertaining the particulars of the fish landed and the place where they are caught. To achieve this end the committee suggests that arrangements should be made for the payment of masters of fishing vessels for filling up returns, and for the engagement of a staff of trained assistants to deal with these returns and with the samples landed and selected for examination. In addition to the research vessels possessed by the central authority in Ireland and by the Marine Biological Association at Plymouth, three special steamers should, the committee think, be provided to study definite sea areas, one to work on the east coast, a second along the west coast of England, and a third to replace the *Garland* on the coasts of Scotland. If the plan formulated by the committee finds approval, each of these steamers will work in connection with a biological laboratory; and each laboratory (in addition to those already established in Scotland and Ireland) will have three biological assistants, while another assistant will be stationed at the office of the central authority in each country. The committee explain that the laboratories at Liverpool and Port Erin (Isle of Man) would meet the wants of the west coast, while that at Plymouth would suffice for the south coast. It would be necessary, however, to establish a new laboratory at some central point on the east coast of England.

Finally, the committee expresses the view that benefit would be derived from the establishment of a National Fishery Museum, which had best be placed at a great fishing center, such, for example, as Grimsby. In this museum might be exhibited such of the specimens of the Buckland collection as are worth preserving; and, it is added, "perhaps it would be found possible to apply Mr. Buckland's monetary bequest for the purpose of such a museum, which might very appropriately be united with the proposed laboratory for the east coast." The original chairman of the committee was Sir Herbert Maxwell, M.P., but he resigned the post last May, since when the inquiry has proceeded under the presidency of Sir Colin Campbell Scott-Moncrieff, whose name appears first amongst the signatories to the report.

OPPORTUNITY FOR GEOLOGICAL RESEARCH IN HONDURAS.

THE great excavations and tremendous cuttings into and through the mountains along the line of the new highway from Tegucigalpa to the south coast have laid bare large parts of these mountains.

I desire to call the attention of geologists and students of geology to this rare opportunity for research in this field of science. It is of especial interest to students in volcanic formations and action. Calcareous deposits abound, and metamorphic formations may be studied minutely. There are excellent exhibits of shale formation as well as of tufa and other igneous conglomerates. Pumiceous deposits and volcanic sand present a fine chance for study at first hand.

These cuttings have entailed an expense of many thousand dollars, and geologists may now profit by the result without any greater expense than that of travel and living while here.

Amapala, Honduras, may be reached by the steamers of the Pacific Mail Line from San Francisco, or from Panama (connecting with Panama R. R. S. S. Co.). The entire expense, including that while in Honduras, should not exceed three hundred dollars.

It would be advisable to make use of tents and camping paraphernalia, as the accommodations for strangers are very crude as well as limited.

Since vegetation is luxurious and of rapid growth in these countries, I suggest that those intending to make a study of these formations do so at once, as the surface of these now bare cuttings, excavations and slides will, in not many months, be overgrown with tropical flora.

ALFRED K. MOE,
U. S. Consul.

TEGUCIGALPA, HONDURAS,

THE NEW YORK COLLEGE OF FORESTRY.

THE trustees of Cornell University at their meeting on June 17 passed the following resolution:

"Owing to the failure of the state to appropriate means for the support of the College of Forestry, established by the state at Cornell University, resolved, that instruction in that college be, and the same is hereby, suspended until ways and means are provided therefor by this state, and that all appointments to the instruction force, including the appointment of the director, be vacated."

In his report to the trustees President Schurman writes as follows:

"The administration of the New York State College of Forestry was undertaken by Cornell University at the instance of the state, the university having neither asked for the establishment of such an institution nor been consulted concerning the terms of the act under which it was organized. But when the legislature framed and the governor approved a bill inviting Cornell University to conduct a great experiment in forestry in the Adirondacks in connection with a State College of Forestry, to be established at Ithaca, the university, in its loyal desire to cooperate with the state in this scientific enterprise, accepted the duty imposed by the act and addressed itself to the task with good faith, diligence, and an earnest determination to carry out the purpose of the state as expressed in the terms of the act itself.

"The first and all essential step was to secure an expert into whose hands, under the general supervision of the trustees, the work might be committed. The university congratulated itself on securing the services of a gentleman who had been thoroughly trained both on the theoretical and practical sides in European forestry, who had lived many years in the United States, and who, after successful experience as a forester for private parties (among whom the late Abram S. Hewitt strongly testified to his merits and success), had for some years held the foremost position in forestry in the United States, namely, that of chief of the Division of Forestry. From this office Dr. Bernhard Eduard Fernow came to the position of Director of the New York State College of Forestry. He outlined

a plan for the conducting of scientific forestry in the tract of 30,000 acres in the Adirondacks which the state had assigned to the College of Forestry for that purpose. The plan grew out of the actual condition of the tract in question. It was a scheme to substitute valuable soft woods for old and rotten hard woods. This meant denudation and replanting. But there is a general prejudice against cutting even old trees and an impatience to wait as long as fifty years for new ones to take their place. Both feelings have been invoked by critics of Director Fernow's work in the Adirondacks. And without going into further detail, the result now is that the state, speaking through its organized authority, desires to have the work stopped. The university stands by its expert. But the university has not the means, even if it had the power, in the absence of state appropriation, to carry on the work of the College of Forestry.

"What is to be done under these circumstances? The President believes that the wishes of the state in regard to the Adirondacks tract which it has placed in charge of the college should be observed as soon as these wishes can be officially ascertained. All that the university need insist upon is indemnity against liability assumed as agent of the state in the contract with the Brooklyn Cooperage Company. If the state, on mature consideration, disapproves of the plan of forestry adopted by Director Fernow, the university has no interest in attempting to force that plan upon the state, however excellent it may be in itself or however extensively it may be practised in Europe or America. Not a cent of state money has inured to the benefit of Cornell University, though the state work in forestry has entailed heavy burdens and anxieties upon the president, treasurer and trustees. It is a hardship to deprive so many students of the opportunity of completing their course, and a matter of regret that the first college of forestry in the United States should be suspended or discontinued, but the action of the state authorities seems to give the trustees no alternative."

SCIENTIFIC NOTES AND NEWS.

DR. CARL GEGENBAUER, the eminent anatomist, since 1863 professor at Heidelberg, died on June 15, at the age of seventy-seven years.

A MONUMENT in honor of Pasteur was unveiled on June 7 at Chartres, near which Pasteur carried on his experiments on anthrax. Addresses were made by M. Chauveau, representing the Paris Academy of Sciences and M. Chamberland, representing the Pasteur Institute. The monument is by Dr. Paul Richer, who is both a sculptor and physician.

PROFESSOR J. H. VAN'T HOFF and Professor Robert Koch, of Berlin, have been elected honorary members of the Vienna Academy of Sciences, and Sir William Ramsay and Professor Georg von Neumayer corresponding members.

M. MUNIER CHALMAS has been elected a member of the Paris Academy of Sciences in the section of mineralogy in the room of the late M. Hautefeuille. Professor H. A. Lorentz, of Leiden, has been elected a correspondent of the academy in the section of physics.

THE HONORABLE ARTHUR BALFOUR, the British premier, has accepted the presidency of the British Association for the meeting to be held in Cambridge in 1904.

DR. D. C. GILMAN, president of the Carnegie Institution, gave the address at the recent convocation at the University of Chicago. The university conferred its LL.D. on Dr. Nicholas Murray Butler, president of Columbia University.

TUFTS COLLEGE has conferred its LL.D. on Dr. Carroll D. Wright, U. S. Commissioner of Labor.

RUTGERS COLLEGE has conferred the degree of LL.D. on Dr. C. M. Ellenwood, president of the Cooper Medical School, San Francisco, and the degree of D.Sc. on Joseph F. Hills, professor of agricultural chemistry in the University of Vermont.

THE degree of Sc.D. was conferred by the Western University of Pennsylvania upon Mr. William Harris Ashmead, the curator of the entomological collections of the United

States National Museum, in recognition of his distinguished contributions to the literature of hymenopterology.

The alumni of the College of the City of New York gave a dinner on June 15 to Professor Alfred G. Compton, acting-president of the college and professor of mathematics. Professor Compton was a member of the first graduating class in 1853, and has for fifty years served the college as instructor and professor.

The Observatory Syndicate of Cambridge University recommends that a pension of £200 per annum be granted to Mr. Andrew Graham, M.A., on his retirement from the position of chief assistant at the observatory, which office he has held for a period of thirty-nine years. Mr. Graham began his work in astronomy at Mr. Cooper's observatory in Markree, county Sligo, in 1842.

Mr. George Whitehouse, engineer-in-chief of the Uganda Railway, has been knighted.

The Harveian Lectures of the Harveian Society of London, will be delivered by Dr. D. B. Lees, next November, his subject being the treatment of some acute visceral inflammations.

Professor H. L. Fairchild, secretary of the Geological Society, sails for Europe on June 27. He will attend the International Geological Congress in Vienna, the last of August, and join the excursion through the Austrian Alps. The time previous to the congress he will spend in geological study in Italy and Switzerland.

Dr. F. H. Herrick, professor of zoology at Western Reserve University, will spend next year abroad.

Dr. Howard S. Anders, instructor in physical diagnosis of chest diseases at the Medico-Chirurgical College, Philadelphia, has been reelected president of the Pennsylvania Society for the Prevention of Tuberculosis, which meets in the Academy of Natural Science in Philadelphia.

Dr. Elihu Thomson has been appointed president of the committee of organization of the International Congress of Electricity, which meets at St. Louis in the week beginning September 12, 1904. The other members of the committee are: vice-presidents, Professor H. S. Carhart, C. F. Scott, Professor W. E. Goldsborough, Dr. W. S. Stratton; general secretary, Dr. A. E. Kennelly; treasurer, W. D. Weaver; advisory committee, B. J. Arnold, B. A. Behrend, C. S. Bradley, J. J. Carty, A. H. Cowles, Professor F. B. Crocker, Dr. L. Duncan, H. L. Doherty, Professor R. A. Fessenden, W. J. Hammer, C. Hering, L. B. Stillwell, C. P. Mathews, R. D. Mershon, K. B. Miller, Dr. W. J. Morton, Dr. E. L. Nichols, Professor R. B. Owens, Dr. F. A. C. Perrine, Professor M. I. Pupin, Professor J. W. Richards, Professor H. J. Ryan, William Stanley, Professor C. P. Steinmetz and A. J. Wurts.

On June 15 Professor G. Jesup, from 1877 to 1899 professor of botany in Dartmouth College, died in Hanover, N. H.

We regret also to announce the deaths of Mr. Alfred Haviland, known for his work on the geographical distribution of disease in Great Britain, at the age of seventy-eight years; of M. Eugen Demarcay, the French chemist, at the age of fifty-one years; of Dr. Stanislao Vecchi, professor of geometry at the University of Parma; of Dr. Dirk Huizinga, professor of physiology at the University of Groningen, and C. L. J. X. de la Vallée Poussin, professor of mineralogy and geology at the University of Löwen.

Reuter's Agency has received the following particulars of the operations of the Danish literary expedition, which consists of M. Mylius-Erichsen, the author; Count Herald Moltke, the painter; Dr. Bertelsen, and a student, M. Knud Ramassen. Last summer they made a voyage in boats along the west coast of Greenland from the colony of Godthaab to the colony of Jacobshavn, where the expedition wintered. In February the expedition started on sledges drawn by dogs for Upernivik (lat. 73 deg. north), the most northerly Danish settlement in West Greenland, which was reached in March. By March 24 the preparations for leaving Upernivik were complete, and some members of the ex-

pedition were about to proceed in a northerly direction along the coast with the intention of reaching Cape York by way of Melville Bay, the shores of which are quite uninhabited, and which have never yet been explored. The object of the journey was to study the tribes of Esquimaux. Dr. Bertelsen was starting southwards through the Danish districts of Umnak, Godthavn and Egedesminde in order to collect material for his book on the diseases of Greenland. He purposed meeting the Cape York expedition on its way home in South Greenland this summer. Several months' provisions for six men and one month's food for six teams of dogs (ten or twelve dogs to a team) were deposited last summer at the most northern point of the Danish coast. All the members of the expedition were well when the letters left.

A CABLEGRAM from Cape Colony to the daily papers says: The German Antarctic steamer *Gauss* has arrived here and will remain about three weeks to refit and then will proceed homeward. The vessel shows outward signs of her experiences in the ice. The expedition has been a great success and not a single casualty occurred among those on board throughout her stay in the Antarctic regions. After sailing from Cape Town, December 7, 1901, the *Gauss* called at Kerguelen Island, where a party was landed. The vessel reached floating ice on February 14, 1902, and was icebound on February 22. The expedition discovered a new land, which they named Emperor William II. Land. It was covered with ice, with the exception of an inactive volcano. The expedition was icebound here for almost a year, the ship being fast in pack ice. The crew went into winter quarters, and many scientific investigations were carried out during this period. Several expeditions with dogs and sleighs left the winter quarters, but found the season too advanced, and their progress was hampered by fearful snow storms and darkness. The *Gauss* made her way out of the ice with northward flowing currents, and, leaving the ice April 8 of this year, she proceeded to Durban, passing Kerguelen Island and calling at St. Paul and New Amsterdam Islands. The expedition enjoyed good health, and there was no sickness, accident or death among its members. Professor Drygalski speaks in the highest terms of the vessel both at sea and in the ice and as regards its equipment. There were enough provisions on board to last the expedition another two years. There was no trouble with the dog teams. The results of the expeditions are briefly: The discovery of a new land in the polar circle and many special investigations. Specimens will be sent on ahead to Berlin. The expedition did not sight the British Antarctic expedition steamer *Discovery*, now icebound in the Antarctic regions, nor the ship *Morning*, which was sent to the *Discovery's* assistance.

THE Philadelphia College of Physicians has passed a resolution requesting its fellows to subscribe for the *Index Medicus*, published by the Carnegie Institution. The Carnegie Institution has appropriated $10,000 annually for its support, but this sum and the subscriptions so far received will not suffice.

THE fourteenth annual meeting of the Museums Association will be held in Aberdeen, Scotland, during the week beginning July 13, under the presidency of Dr. F. A. Bather, of the British Museum, who opens the conference with an address at 10 A.M., on Tuesday, July 14. Meetings for the reading and discussion of papers will occupy the mornings of Tuesday, Wednesday and Thursday, while there have been arranged excursions to Balmoral and Dundee, visits to the Art Gallery and Museums of the city, and various social festivities. A special attempt is being made to induce museum officials from the continent of Europe to attend the meeting, and it is particularly hoped that some American visitors to Great Britain may find it possible to be present. Some museum curators may be passing through on their way to the International Geological Congress at Vienna, and we are requested to state that the presence of those or any others interested in museum questions would be warmly welcomed at Aberdeen. Any who propose to avail themselves of the invitation should, if possible, communicate beforehand with the secretary of the

association, Mr. E. Howarth, Public Museum, Sheffield, England.

The English electrochemical society, to the steps for the organization of which we have already referred, will be known as the Faraday Society, and will hold its first meeting on June 30.

The Lake Laboratory buildings at Cedar Point, Sandusky, Ohio, will be formally opened on July 2. Addresses will be made by Professor Herbert Osborn, director of the laboratory and professor of zoology in the Ohio State University, by Professor C. J. Herrick, president of the Ohio Academy of Sciences and professor of zoology at Denison University, and others.

The whaling ship *Gjoa,* with an expedition under the command of Captain Ammundsen, has left Christiana to study the conditions about the magnetic North Pole.

Reuter's Agency is informed of the arrival on June 11 at Obbo, to the southeast of Gondokoro, of Major Powell-Cotton, Northumberland Fusiliers, who for the past year has been traveling in Central Africa. When last heard of he had been studying the cave dwellers at Mount Elgon and was proceeding towards the Upper Nile. He then expected to reach Wadelai in February.

Nature reports that in the House of Commons Mr. Austen Chamberlain, speaking on the vote for the telegraph services, referred at some length to the relations between the postoffice and the Marconi Wireless Telegraph Co. He said that the postoffice had no desire to check the progress of wireless telegraphy, nor could they have done so had they wished, as their monopoly did not extend beyond the three-mile limit. The Marconi Co. had, however, asked for too much; in the first instance they asked to be given a permanent and exclusive right to work wireless telegraphy in this country, which he could not grant, especially after the postoffice's experience with the telephone system. He had, however, granted them a private wire to Poldhu on the ordinary terms as soon as they asked for it, but before undertaking to act as their agents for the collection of messages, as was done for the cable companies, the postoffice required that certain conditions should be fulfilled in order to safeguard the admiralty, and also asked that their experts should be satisfied that the company were able to carry on their business and transmit messages across the Atlantic commercially. He was still waiting an answer to this request, which was made last March.

The *Experiment Station Record* states that the legislature of Hawaii at its recent regular session provided for a reorganization of the office of the commissioner of agriculture by placing the duties of that office under the control of a non-salaried board of five commissioners. The new law defines the duties of the board and provides for the enforcement of its regulations. Under the new arrangement particular attention of the board is given to forestry, entomology and inspection of plants, fruits, etc., to prevent the admission of injurious fungi and insects. For this work paid superintendents and assistants are provided. For the development of general agriculture, cooperation with the experiment station established by the U. S. Department of Agriculture is to be sought.

We learn from the New York *Times* that as the result of plans that have been developed since early in the spring the American Museum of Natural History has arranged to loan to the biology departments of as many of the public schools of Greater New York as may make proper application collections of invertebrate specimens for use in connection with the school biological work. It was found that two sets of collections could be prepared, one, known as the duplicate collection, consisting of about forty-five specimens, covering between thirty and forty species and illustrative of general characteristics, and the other, a specialized collection of from one hundred to one hundred and fifty specimens, collected and arranged with a view to showing typical forms of different species, and wherever possible, bring out some essential fact in the development of the type. Ten schools have applied for the first of the collections, now ready for distribution.

A REPORT on technical high schools in Germany by Dr. Frederick Rose, British Consul in Stuttgart, has been issued by the British Foreign Office. According to an abstract in the London *Times* Dr. Rose begins by referring to his previous report on chemical instruction and the chemical industries in Germany (No. 561 in the same series), in which he demonstrated that by means of thorough chemical education in the universities and technical high schools Germany had in the course of half a century risen to the front rank in the nations of the world in chemical industry, so that her chemical products are now valued at about 50 millions sterling yearly—a sum which is considered as the interest accruing from the capital invested by the country in chemical education. The present report deals with the technical high schools of the country generally, as their part in the industrial progress of the country has been very important. At present there are nine of these institutions in Germany—at Aix, Berlin, Brunswick, Darmstadt, Dresden, Hanover, Karlsruhe, Munich and Stuttgart, while one at Danzig is to be opened shortly, and one at Breslau in the course of three or four years. Most of them date from the years succeeding the fall of Napoleon, when they were founded as small trade or technical schools; then they passed into the stage of polytechnic schools, and during the last quarter of a century into that of technical high schools, while they now grant degrees and rank with the older universities. They are all in towns of 100,000 inhabitants and upwards, and their growth and progress are coincident with the transformation of Germany from an agricultural to an industrial state. The German universities have always taught some branches of pure and applied science, but they have always regarded the economic application of science as inferior to research in pure science; chemistry is an exception to this rule, but the idea of technical education has never been able to assert itself as equal with the pursuit of knowledge and science, and hence the necessity for the technical schools.

WATER-SUPPLY Paper No. 80, now in press, United States Geological Survey, by Mr. George W. Rafter, deals with the subject of the relation of rainfall to run-off. Some of the many conclusions of the paper are here given. Mr. Rafter holds that there is no general expression giving accurately the relation of rainfall to run-off, every stream being, in effect, a law unto itself. The cause of rainfall, beyond the cooling of the air below the dew point, is not very well understood; and it is uncertain whether rainfall is in any degree increasing. Rainfall and run-off records are conveniently divided into storage, growing, and replenishing periods, a large percentage of the total water supply running off during the storage period. The run-off of streams has been generally overestimated. Evaporation is a persistently uniform element, and streams with large evaporation are, so far as known, always deforested. Ground water must be taken into account in order to understand all peculiarities of stream flow; and a very important effect of forests is in increasing the ground-water flow, so that it may be said that the removal of forests notably decreases minimum stream flow. It is uncertain whether forests in any way influence the quantity of rainfall. As a broad proposition merely it may be said that catchment areas from which municipal water supplies are drawn should be heavily forested. Nevertheless, Mr. Rafter thinks that it would not be a good investment for the city of New York to undertake to reforest the Croton catchment area; and for this opinion he assigns the following reasons: To acquire the entire watershed—a necessary prerequisite—and to plant it in trees would cost, on a very conservative basis of estimate, about $24,000,000. There would be some consequent increase of water supply after about 30 years, but 120 years would be needed to realize the full effect of forestation and to produce the estimated resulting additional supply of about 75,000,000 gallons per day. By the expiration of the 120 years, however, the original cost compounded at three per cent. interest would

amount to about $780,000,000, a sum out of all proportion to the resulting daily increase of water supply. Hence the attempt to increase the water supply by forestation of the Croton catchment area is inexpedient.

UNIVERSITY AND EDUCATIONAL NEWS.

Announcement of a gift of $150,000 from Mr. J. Ogden Armour was made at the convocation exercises of the Armour Institute of Technology on June 19.

The committee appointed by the Columbia University council to prepare a report on 'what celebration, if any, should be held on the one hundred and fiftieth anniversary of the foundation of the corporation,' which occurs on October 31 next, has made the tentative suggestion that the commemoration last from October 25 to November 1. On October 25, 26, 27, 28, a series of colloquies, conferences and lectures is proposed to be delivered by eminent European and American scholars. On October 31 there will be a luncheon and reception in honor of the guests, and an address, historical in character, by the president of the university.

Arrangements have been made between the Western Reserve University and the Case School of Applied Science permitting students to complete their academic and engineering courses in five years.

Colgate University has given up its degree of Ph.B. and will hereafter give the B.A. degree without required Greek.

Charters have been approved incorporating independent universities at Manchester and Liverpool to be known as the Victoria University of Manchester and the University of Liverpool.

On June 18 the corporation of Brown University voted to establish a graduate department and elected Professor Carl Barus as dean.

Dr. le Baron Russell Briggs, professor of English and dean of the Faculty of Arts and Sciences at Harvard University, has been elected president of Radcliffe College to fill the vacancy caused by the resignation of Mrs. Agassiz.

Professor M. E. Cooley, of the engineering department of the University of Michigan, has been offered the deanship of the Engineering School of the University of Wisconsin.

Dr. Frederick E. Bolton, professor of education in the University of Iowa, was offered the presidency of a normal school at Manila, Philippine Islands, but has declined the position.

The Rev. Dr. Smith, for the past twenty years president of Trinity College, has resigned. Dr. F. S. Luther, Jr., professor of mathematics and dean of the faculty, is acting president.

Dr. J. J. R. McLeod, assistant demonstrator of physiology at the London Hospital, has been appointed professor of physiology at Western Reserve University, occupying the chair made vacant by the removal of Professor G. N. Stewart to Chicago.

Professor C. H. Robinson has resigned the chair of physics at Rochester University.

H. C. Ives, instructor in Worcester Polytechnic Institute, has accepted an assistant professorship of civil engineering in the University of Pennsylvania.

The three scholarships available for members of the Harvard summer course in geology in the Rocky Mountains open to general application have been assigned to Chas. W. Brown, of Rhode Island, graduate of Brown University and instructor; W. S. Tower, of Massachusetts, student in Harvard University, and P. H. Cormick, of Texas, student in the University of Tennessee.

Mr. Alfred Hughes has been appointed professor of education at Birmingham.

Mr. Carveth Read has been appointed to the Grote professorship of philosophy of mind and logic at University College, London, in succession to Professor James Sully.

M. Daniel has been elected to a newly-established chair of agricultural botany at the University of Rennes.